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STATE'S RÔLE IN THE RECONSTRUCTION OF INDIA'S MINERAL POLICY

THE Geological Societies in India have been organising of late, symposia for formulating a national mineral policy for India. The trend of discussions which have taken place so far discloses a strong feeling for nationalisation and conservation of India's mineral resources for her own needs. If 'nationalisation' were to mean that the Central Government should hold the mineral rights throughout India and own all the mines, several complications are bound to arise. But if it suggests that the rights for minerals as distributed within the territorial jurisdictions of the several Indian States and British Provinces should vest in their respective Governments, the question assumes a simpler aspect. In fact, in most of the Indian States, and even in many of the British Provinces—except perhaps where permanent land settlement prevails, as in Bengal, Bihar and Orissa—the mineral rights vest already in their Governments. Whatever else may be the reason, it is not the lack of State ownership of mineral rights which has been the root cause for the unsatisfactory and tardy growth of India's mining and mineral industries.

So far, most of the Indian States and Provinces have left the prospecting and mining of their minerals to private enterprise. Foreign concerns with adequate mining experience and ability to command the required capital, took advantage of this and got possession of some of the valuable deposits of metalliferous minerals, like the ores of gold, manganese, chrome and copper. Many of these concerns generally conduct their mining with considerable skill and forethought, adopting the latest and the most advanced methods. The country, no doubt, has been largely benefited by their enterprises; but it is questionable whether the return it has got is quite proportionate to the total drain of its mineral wealth. Indian capitalists have fought shy in the past of risking their funds in mining, and the few who have ventured on these lines have generally concentrated their attention on raising only the minerals which can be readily exported without any further treatment or elaborate processing.

Many of the smaller concerns—due to their inadequate provision of funds, want of technical experience, absence of forethought

in planning, need of co-operative efforts, and also from the lack of vigilant State control to prevent and prohibit slipshod works—have been following the most wasteful and unprofitable methods of mining. The unscientific and uneconomical ways in which the coal deposits of the country are being mined and used have been pointed out so often that it is hardly necessary to mention them here. The reprehensible practice of scooping out only the best and the most easily accessible portions of the deposits leaving the rest untouched, would lead to the rapid depletion of most of our economic mineral resources as it has already happened in the case of manganese ores and mica. It should be remembered that mineral deposits, unlike forest or agricultural products, are the irreplenishable assets of the country. They cannot be accelerated in growth, or rejuvenated, by any scientific skill. No human efforts can either create a deposit if it does not exist or replenish that which may become depleted by extraction. Consequently, to get the utmost out of any deposit, scientific development and intelligent mining are absolutely essential and should be insisted on by the State. Large scale, serious efforts have yet to be made to investigate the possibilities of beneficiating the low grade ores of useful minerals, like chrome and manganese, and to use them widely in suitable local industries. An adequate local demand remains to be created for minerals like China clay, quartz, felspar and limestone which are widely distributed in the country and which can serve as raw materials for several useful industries. These common minerals have hardly attracted any attention and are lying almost as if they are unutilisable waste.

The growth of India's mining industries has proceeded so far without any organised plans or policies initiated by the State tending to meet the needs of the country at large. It is time for the State to change its passive policy. It cannot serve the country's interests effectively if it merely functions as the custodian of its mineral wealth or only an organisation for the collection of royalty. It should actively participate in the development of its mineral resources, formulate workable plans, initiate and aid the establishment of suitable mineral industries and guide their growth, and also manage a few—by its own organisations—to create confidence in the public and raise their interests in mining matters.

It may not be practicable for any Government to manage all the large-scale mining and mineral industries which can be suitably set up in the country. It is not desirable either that it should do so and prevent private enterprise. A concerted and co-operative effort between the State and its public for developing the country's mineral resources may work all the better. Indian capitalists are now coming forward to invest some funds in large-scale mining and mineral industries if they can get reliable technical advice and guidance. As far as possible it should be the duty of the State to furnish such technical advice when sought for, charging—if necessary—a reasonable fee.

The geological services available in India are very inadequate for such purposes considering the vastness of the country with its mineral deposits widely scattered. The Indian Geological Survey is stationed at Calcutta and its insufficient staff cannot serve the present needs of the whole country. Some of the enterprising Indian States have organised their own geological survey departments; but even these are poorly staffed and ill-equipped for modern methods of intensive investigations relating to mineral prospecting, mining, or ore treatment. Geology, as a private profession, has been hardly remunerative in India, as it has been in the advanced countries in the West; and, consequently, we find very few qualified and competent men practising as consulting geologists and mining engineers. As the first essential for a nation-wide policy to galvanise the rapid growth of India's mining and mineral industries, the State should create at once an adequate, efficient geological service for the country.

A Mineral Survey Department—with an adequate staff of competent geologists—should be organised immediately in each of the provinces, and such of the bigger Indian States as do not have that department, to conduct an intensive mineral survey. These departments should collect, as early as possible, accurate information on the extent and quality of all the economic minerals distributed in their respective territories. They should handle all problems connected with mineral extraction and utilisation, and exercise technical control over the mining and prospecting works of mineral concessionaires, to see that they

open out the deposits on approved systematic lines. They should do all the investigatory work in respect of the important deposits of their useful minerals; and may, with advantage, mine a few on the best approved modern methods to serve as models for the others,—like what Mysore has done in the case of some of her chromite, kaolin, and graphite deposits. Want of space precludes me from going into further details on the functions of these departments; in general they have to act as advisory institutions to their respective Governments as well as to the public on all matters connected with geological and mineral investigations.

These States and Provinces should have each, in addition, a "Mineral Utilisation Board", composed of the heads of the Mineral, Industrial Chemistry, Industrial Engineering and Industries Departments, to investigate ways and means for the local utilisation of minerals and to advise their respective governments as to the industries which they can advantageously set up.

It is very rarely that a single State or Province will have all the advantages it needs for establishing successfully any large-scale mineral industry. The best interests of India require a certain measure of co-operation and concerted planning among her various territorial units, and a free interchange of mineral products between the Provinces and States. To effect this, the Central Government should constitute a "National Mineral Utilisation Board" (apart from the present Utilisation Branch of the Indian Geological Survey) consisting, among others, of the heads of various provincial and State mineral survey departments, as its *ex-officio* members, to deal effectively with all mineral problems affecting the whole of India. This Board should co-ordinate the efforts of the several provincial and State mineral organisations, and discuss and decide the group of mineral industries which each of them can advantageously set up without any hitch or unhealthy competition amongst them. It should have, working under its general direction, several standing advisory committees like the following:—(1) Ceramic and refractory minerals committee, (2) Abrasive minerals committee, (3) Mineral Fuels committee and (4) Metalliferous minerals committee. Each of these should consist of a small body of experts who could deal authoritatively with problems connected with their sections and advise the National Mineral Board.

The Government of India should set up as early as possible a well-equipped "Central Mineral Research Institute" (on the model of the United States Bureau of Mines) to which any problems arising in the country on the various aspects of ore dressing, ore concentration, metallurgical treatments, etc.,—which the provincial and State organisations for want of adequate facilities cannot investigate—can be handed over for solution and advice. Apart from these few suggested ways there are several others in which the Central and Provincial Governments can aid the active growth of mining and mineral industries in India, which cannot be dealt with here.

The question of India's future policy in respect of conserving all her mineral resources is a delicate problem which needs handling with care and forethought. Nature's gift of her mineral wealth has not been based on the specific needs of any particular nation. No single country in the world can be regarded as absolutely self-sufficient in respect of all her mineral requirements for war and peace-time purposes. The present-day civilisation needs for its existence several minerals, and new ones are being continually added on to the list of those which may be considered as essential for the further progress of civilisation. Sir Thomas Holland, in his opening address at the Conference on "Mineral Resources and the Atlantic Charter", pointed out the other day (July 1942), that no civilised country can now exist without an adequate and sufficiently varied supply of mineral products and that tariff barriers, while capable of hampering international trade in mineral products, cannot prevent these trades altogether without creating conditions ultimately leading to war. He urges in consequence the formulation of measures to facilitate the international flow of mineral products.

The absolute need and the advantage of having a free interchange of mineral products cannot be gainsaid; but no good will result if the dominant nations were to decide these policies and jointly control the minerals of the former colonies and dependent States, prejudicial to the interests of those or of other weaker countries. Each country should have full scope to decide what its reasonable mineral requirements would be for its own development.

Among her mineral possessions, India can list, in all about a hundred or so of different types, which may serve for various industrial purposes. It would not pay to export, in their raw condition, many of these which may be classed as common minerals. They may be used advantageously in some one or the other of the several local mineral industries to which each would be found best suited. Among the minerals of international importance which would be required in the world's essential industries, India may possess a dozen including her high grade iron ores, bauxite, manganese ores, chromite, mica, monazite, ilmenite and a few others. Excepting iron ores and bauxite, India has been exporting the others, till now, in unrestricted quantities; and it is highly doubtful whether we have these minerals in such super-abundance—far in excess of our requirements—as to continue to share them for long, as common raw materials, with other countries.

India, in its present stage of industrial development, may not be conceded to be standing in need of a large share of the minerals of international importance; but the country's growing requirements necessitate the setting up—not at some distant future but immediately—of several essential industries which would require them as their raw material. In any consideration for an international mineral policy India cannot stand in isolation, and we do not mean either that she should do so and play the dog in the manger role in respect of her mineral resources. The Government of India, the Provinces, and the States, should endeavour to take an accurate stock of their mineral resources—as suggested above—and decide upon the various mineral industries which each could advantageously set up, so that when the time comes—which may not be far distant—for any considerations of international sharing of resources of essential minerals, India may have her plans ready and show the world her own need for most of the minerals which she possesses and for a few more which she has not got.

B. Rama Rao.

THE CURRENT SCIENCE ASSOCIATION

FRIENDS of *Current Science* will learn with great satisfaction that the Journal will henceforward be conducted and issued under the auspices of the "Current Science Association", a body which has been registered under the Societies' Registration Act 21 of 1860.

During the last ten years of its eventful career, the Journal has steadily earned for itself a prominent place in the field of international science and this happy circumstance is due to the whole-hearted and active support it has received from the several Governments, Universities, Research Institutes and the scientific workers in this country. During this period of its infancy, the Journal has had its share of teething troubles which fortunately have now been successfully overcome. The Journal now enters its second phase of development. With a view to ensure an ordered and steady progress, the Journal has been invested with a Constitution consistent with its All-India character.

At the end of 1941, the Editorial Board invited an *ad hoc* Committee to constitute itself and draft a constitution for the management of the Journal. After framing the Constitution, the *ad hoc* Committee advised the Editorial Board, at a meeting held on January 13, 1942, that immediate steps should be taken to register the "Current Science Association". This suggestion was brought up for consideration before the Board of Editors at a meeting held on February 5, 1942, when they resolved to adopt the following:—

1. To register the "Current Science Association" with a membership not exceeding one hunndred.
2. To appoint a Working Committee to administer, direct and manage the affairs of the Journal.
3. To transfer all the assets and liabilities of the Journal to the Working Committee of the Association.

The Working Committee has been constituted under the Presidentship of Sir Jnanchandra Ghosh; the Committee has appointed an Editorial Committee consisting of an Editor, a Secretary and a Treasurer to whom responsibility of the routine running of the Journal has been entrusted.

COSMIC RAY RESEARCH UNIT

INDIAN INSTITUTE OF SCIENCE

THERE is no doubt that the ultimate aim of all scientific activity is the discovery of the laws governing the behaviour of both the inanimate and animate world in order that the forces and properties of nature may be used for the benefit of humanity. The research work which has to be done before the forces of nature in any field can be used for human ends can be divided roughly into three stages. The first stage is one of pure research where the laws governing the phenomena in that field are still being investigated. The second stage is one where sufficient knowledge of the laws has been acquired to enable one to think of ways and means of applying them for human ends. The third stage is one in which our knowledge of nature in the particular field concerned has already been put to practical application, and research consists mainly in perfecting the existing appliances and methods by technical improvements. It is clear that of the three stages the first is the one which is most pregnant with possibilities for the future, and, indeed, without it the two subsequent stages could not exist. This type of research is usually described as 'pure' research for the simple reason that its applications are still too remote to be foreseen even by those actually engaged in the research. The third stage is called 'applied' or technical research, and industrialists are most easily induced to finance this stage since no particular vision is required to see the immediate benefits which result to mankind in general and their own pockets in particular from this type of activity. But it is obvious that technical or applied research can never open up entirely new fields for the service of humanity.

The history of wireless provides an excellent example of the process of development outlined above. The electromagnetic nature of light had been put into evidence by the researches of Faraday, and the laws of electricity and magnetism were put into their present mathematical form and expressed as a set of equations for the first time by Maxwell at about the middle of the last century. Maxwell realised that his equations required that electromagnetic disturbances should also be propagated through space with the velocity of light, and deduced that electromagnetic waves must exist in nature. It was left to Hertz to actually establish in 1887 that such waves are in fact sent out when a condenser is discharged. The second stage set in when following this result scientists tried to produce such electromagnetic waves artificially and to devise suitable apparatus for their detection. Then a student, Lord Rutherford was one of the first to make a detector to detect such waves which had passed through several brick walls over a distance of a hundred yards. This was in 1895, before Marconi had taken up the subject. The practical importance of these waves was immediately recognised, and several inventors including Marconi, began the attempts to improve the apparatus so as to make the transmission of signals more reliable and to extend it to increasingly greater distances. The third stage began when wireless telegraphy had become a fact and it was only a matter of improving the instruments and technical devices to bring radio to its present stage of perfection. This history brings out very clearly that wireless as we know it could not have existed without the pure researches of Faraday and Maxwell, and that at the time when Faraday and Maxwell did their work they could not even have foreseen the possibility of wireless communication and television.

In the case of Nuclear Physics we have the example of a field in which the first stage of pure research has been almost completed, and we are entering the second stage of attempts at application, with important successes in certain directions. Nuclear physics has already found a remarkable application as an instrument for the investigation of biological and physiological phenomena and allows us to tackle the problems of intermediary metabolism in a direct way which would be extremely difficult otherwise. The possibilities of its use in the treatment of hitherto incurable diseases also cannot be overestimated. On the theoretical side, our present knowledge

of nuclear physics has already enabled us to understand the process of stellar evolution for the first time. Finally, nuclear physics has opened up the possibility of extracting from a gram of matter a million times more energy than we extract at present by the process of chemical combustion, and there is no doubt that the practical application of nuclear physics to power production will put the most immense sources of power in human hands in the future. The problem is only one of doing on a practical scale what can already be done in the laboratory. Under the stimulus of war, money is being lavishly spent in America and Europe to find methods of using nuclear energy in a practical way and we may look forward to a successful application of nuclear physics to power production within the next few years. In nuclear physics, therefore, we have the example of a field in which the first stage has been largely traversed and we are entering the second.

In the case of cosmic rays we are still very much in the first stage. The great importance of cosmic rays is that on a single particle of cosmic radiation there is sometimes concentrated more than a million times the energy concentrated on any particle produced in nuclear phenomena, which in its turn is several hundred thousand times more than the energies involved per atom in the ordinary chemical and physical processes on which our life depends. Cosmic rays, therefore, provide us with the only means of studying matter in realms far beyond those studied by nuclear physics. The study of cosmic rays has already revealed certain absolutely fundamental processes of nature which have led to a revolution in our ideas of the physical world. The creation and the annihilation of matter has been established and effected in the laboratory and the existence of a new fundamental particle in nature, the meson, responsible for the stability of nuclei, and in consequence of matter in general, has been revealed. The laws governing one entire side of the cosmic ray phenomena are now completely known and expressed in mathematical form in the cascade theory first put forward by Bhabha and Heitler. But the behaviour of the more penetrating component of cosmic rays is still only partially investigated and there is every reason to believe that a complete understanding of the behaviour of the penetrating component will lead to a vital extension of our knowledge of the physical world.

The Sir Dorabjee Tata Trust, whose management consists of the foremost industrial interests in this country and whose far-sighted and generous munificence has been supporting many a scheme of fundamental research in this country, has now financed the setting up of a Cosmic Ray Research Unit at the Indian Institute of Science, under the direction of Dr. H. J. Bhabha, F.R.S. It is hoped that it will be possible to fill in some of the more vital gaps in our knowledge of the penetrating component mentioned above by experiments carried out in the laboratory of the Unit and by high altitude balloon flights as well as by mathematical investigations. It would be pointless to ask a cosmic ray physicist to-day of the possible applications of his work, for he is still in the stage in which Maxwell found himself when he formulated his equations. Nevertheless it can be confidently said that a complete understanding of the phenomena of cosmic rays will have the most far-reaching effects in our understanding of some of the most remote problems of the structure of the universe on the one hand, and open up realms at present undreamt-of for the benefit of humanity on the other. Indeed, it is held by some scientists that the mutations upon which all biological evolution depends are stimulated by cosmic rays, so that it is not beyond the realm of possibility that the very process of animal and human evolution may depend on the existence of cosmic rays. At the present rapid rate at which science progresses, we may hope that in another ten or fifteen years the entire field of the purely scientific aspects of cosmic rays will have been investigated and that we will be in a position to think of the application of the knowledge so obtained to practical purposes.

WOOD AS A MATERIAL OF CONSTRUCTION

THE present scarcity of metals has focussed attention on the possibilities of timber as a substitute material. And substitutes have a habit of coming to stay. This possible outcome of what at present is forced war-time economy is to be welcomed because timber, quite apart from the shortage of other materials of construction, has received all too little attention in this country. One needs to be reminded that the very word "timber" tells a tale—being derived from Greek and Latin roots meaning "to house", "to build". And while the utilisation of timber as a material of construction and also as a source of food, drink and clothing, as a source of energy and as a source of raw material for a bewildering range of processing chemical industries has made phenomenal advance in other countries, we in India have for the most part not kept pace with these developments. An index of our backwardness in this respect is well provided by our almost complete dependance on imports (which at present are very much restricted) even for such a comparatively simply processed wood product as plywood.

The chief reasons for this state of affairs are our innate conservatism coupled with our ignorance until very recently of even the basic properties of Indian timbers. It was easier to import. And as a direct result of the propaganda on behalf of other materials of construction these latter actually made inroads into even the limited fields where timber thereto held sway. In India, unlike for example in the U.S.A., the Government happen to be the principal owners of timber and in the nature of things could not keep up the same kind and amount of sustained and subtle forms of publicity which competitive materials with powerful interests behind them put forth for the favour of the consumer. It was, therefore, inevitable that timber not only did not make any headway but actually lost ground as a material of construction.

Added to these was another factor which is not peculiar to this country. This may best be described as the psychological factor; for example, such a statement as "timber is not strong" would appear in quite a different light when the weight-strength ratio is considered—weight for weight, a timber could actually be "stronger" than some metals. But this needs to be said and said loudly and often. Again, the drawback alleged to timber that it is not permanent loses much of the point in the light of the modern concepts of economic permanence—that no component of a structure need outlive the usefulness of the structure itself. Anyway, modern methods of preservation have very greatly prolonged the "life" of timbers. Again, while it is true that timber is combustible, it does not follow that it is necessarily the first to give way in any actual fire; metals may also fail at temperatures that are encountered in "fires". And economic processes have been evolved which make timber if not fire-resistant at least fire-retardent. Enough has been cited to indicate the nature of the misconception and half truths associated in the popular mind with timber. Such prejudice and ignorance have been combated in other countries by the twin weapons of educating the public, on the one hand, on the truth about timber and its limitations, and on the other by sustained research which tries to exploit to the utmost the characteristic properties of wood, and, yes, even to improve upon nature by appropriate modifications. The courses on timber engineering in some of the continental engineering colleges and the Timber Development Association in England are classical examples of the first approach to this problem while "Masonite", metal-faced plywood, and "Teco" timber connectors stand out as monuments to recent research in timber.

No greater harm could be done to the cause of timber utilisation than to claim that all timbers are good for every purpose. Timber is not ductile; it splits easily along the grain; it is not hard enough for some purposes. These are some of the major limitations that must be squarely faced. But, timber is light, easily worked with simple equipment to different shapes, easily fastened together, has a comparatively high salvage value and is a poor conductor of heat and electricity, and is susceptible to a minimum corrosion. This is a very valuable combination of properties in a material of construction quite apart from the æsthetic aspect which can, as in interior decoration, become an all-important matter. Timber could be finished to give a variety of attractive effects, while the grain, texture and figure of timber render possible decorative schemes which, for individuality and variety are hard to beat. In short, from the æsthetic point. timber has almost a personality of its own,

There are certain other features in timber utilisation which are of importance in our country. Timber is the material *par excellence* for construction by the villager. Thus, for example, the low first cost and easy workability of timber must be exploited to the utmost in the solution of our rural transport problem. In these areas, the traffic does not warrant the heavy outlay on steel bridges to span the innumerable streams which often maroon entire villages. Treated, preframed timber bridges would offer a solution. Suitable type designs could be prepared; and the small timber members going into such a structure could generally be had in the neighbourhood of the site itself. The carpentry and the labour for erection could be provided by the village community itself. The preservative material and the fasteners are the only materials to be "imported". Unlike in steel construction, the greater part of the material and labour would be indigenous and thus contribute largely to its total low cost, and keep even this little money within the community. If the traffic should develop beyond the capacity of such a modest structure, or at the end of its normal life—which need be no more than ten to fifteen years—*another* bridge could easily be built.

In India, institutions designed and devoted to timber research are woefully few. And these few are doing pioneer work, often against odds. They can no more than touch the fringe of the problem. But, their work has already succeeded in putting some "condemned" species on the utilisation map of the country. Such, for example, is the gradual replacement by indigenous timbers of imported ash and hickory handles. They have done a great deal to educate the public on timber preservation. They have also been directly responsible for the starting of a few timber industries. This should be viewed as no more than a promise of what could be done. Japan, for example, has transformed the humble bamboo into a prime constructional material. The same can and must be done for Indian timbers. Unlike in temperate climates, the number of species in Indian forests are bewildering and neither are the crops homogeneous. The country is so vast that not only do the species differ from region to region but the properties of the same species vary according to its habitat. These complications necessitate sustained research in laboratories devoted to forest products and strategically located all over the country. The work of these institutions has to be planned and translated into industrial practice through a *liaison* agency. And finally the innate conservatism of the consumer and any of his prejudices against timber must be combated by intelligent and sustained propaganda coupled with readily available instruction on the most effective and modern methods of using timber. Such a planned programme does involve considerable outlay. Experience in other countries has proved such expenditure to be good investment. There is no reason to believe that it would be otherwise in India.

MR. D. N. WADIA, M.A., B.Sc., F.G.S., F.R.A.S.B., F.N.I.

We have very great pleasure in announcing the award, by the Council of the Geological Society of London, of the Lyell Medal to Mr. D. N. Wadia, Government Geologist, Ceylon. According to the conditions of the 'Lyell Geological Fund', this Medal is awarded annually by the Geological Society "as a mark of honorary distinction and as an expression on the part of the Governing Body of the Society that the Medallist has deserved well of the science", and the award of this medal to Mr. Wadia this year is an honour which he richly deserves. Mr. Wadia is well known as one of the foremost Indian geologists in the country, and both as a teacher of Geology as Professor in the Prince of Wales College at Jammu, and later, as an active and enthusiastic field geologist on the staff of the Geological Survey of India, Mr. Wadia has contributed in no small measure to the promotion and progress of geological studies in India. Apart from this, he has all along taken considerable interest and played a prominent part in the work of the various scientific bodies in India, in recognition of which honours and distinctions have been freely conferred upon him. Ever since its inception, *Current Science* has been fortunate in securing Mr. Wadia's wholehearted support and co-operation; and we take this opportunity of offering him our sincere felicitations on the signal honour that has now been conferred upon him by the Geological Society of London. We wish Mr. Wadia many more years of active service in the cause of science in India.

OBITUARY

SIR BRYCE CHUDLEIGH BURT, Kt., C.I.E., M.B.E., B.Sc., I.A.S. (Retd.)

We very much regret to record the death of Sir Bryce Burt, retired Vice-Chairman of the Imperial Council of Agricultural Research in England in January 1943 at the age of 62.

Sir Bryce was born in April 1881 and graduated from the University College, London, in 1901 with first class Honours. While a student in the University, he was a Clothworker's Exhibitioner in Chemistry. After graduating he was for a couple of years (1902-1904) assistant lecturer in Chemistry at the Liverpool University. From 1904-1907 he was at Trinidad, British West Indies, as assistant Government Chemist and lecturer in Tropical Agriculture. He joined the Indian Agricultural Service in India in January 1908 and was posted to United Provinces as Deputy Director of Agriculture and this post he held for a period of thirteen years until 1921. During this period for a term of three years (1912-1915) he did the duties of the Director of Industries of the Province also in addition to his agricultural work. When the Indian Central Cotton Committee was constituted in 1921, he was appointed its first Secretary, which post he held for seven years, until 1928. After this he was appointed for the short period of a year Director of Agriculture in Bihar and Orissa and was later appointed the first Agricultural Expert to the Imperial Council of Agricultural Research (since changed into Agricultural Commissioner to the Government of India) when it was started. He acted for two short periods as Vice-Chairman of the Imperial Council of Agricultural Research and became the permanent Vice-Chairman in October 1935 when Sir T. Vijayaraghavacharya retired. In 1932 he went to Ottawa for five months as the official Adviser to the Indian Delegation to the Imperial Economic Conference. Later, he was one of the Advisers to the Indian Trade Delegation in 1937. He retired and left India in April 1939 after thirty-one years of service and having reached the highest post open for a person belonging to Indian Agricultural Service. After retirement, when war started in September 1939, he joined the Food Ministry and was working in it as the Director of Animal Feeding Staff until the time of his death.

One outstanding feature of Sir Bryce Burt was his organising capacity with a mastery of details and this was apparent from his work, particularly in the two new bodies, the Indian Central Cotton Committee and the Imperial Council of Agricultural Research. He was a man of extraordinary energy and his knowledge of things was encyclopœdic which was the result of his varied activities in the early years of his service. People who had worked with him in U.P. in the early years used to say that Burt was always a busy body, would never spare himself nor let others associated with him take things easy. To quote the words of the reviewer of his career in India when he retired from service in 1939, "Probably no single man has so deeply influenced Indian Agriculture in so many directions as Sir Bryce Burt did". The setting up of the agricultural marketing organization and the promotion of technological research directed to elucidating the factors determining quality in agricultural products might be said to be two of the outstanding features of his activities.

As Chairman of the Imperial Council of Agricultural Research, he was *ex-officio* Chairman of so many bodies, namely, the Indian Central Cotton Committee, the Indian Central Jute Committee, the Indian Lac Cess Committee, the Indian Coffee Cess Committee, and both wings of the Board of Agriculture and Animal Husbandry in India. He took great interest in the development of Soil Science and was largely responsible for starting the Indian Society of Soil Science. He was a foundation fellow of the National Institute of Sciences in India and one of the Editorial Co-operators since the

inception of *Current Science*. He was a familiar figure at the various sessions of the Indian Science Congress Association and was the President of the Agricultural Section in 1924.

By his vast knowledge of things connected with every branch of Agricultural Science, he commanded the esteem and regard of all the Agricultural Officers throughout India. He was always a sound judge of men and was easily approachable and kind to the junior Agricultural Officers. Anyone who went to him for consultation and discussion always returned with additional knowledge to his benefit.

Government was not slow in recognising the value of his work and honours bestowed on him were numerous—Kaiser-i-Hind Medal in 1912, M.B.E. in 1919, C.I.E. in 1930 and Knighthood in 1936.

We offer our condolences to Lady Burt and the family of late Sir Bryce Burt.

MR. V. S. SAMBASIVA IYER, B.Sc., L.C.E.

WE regret to report the death, on 10th January 1943, at Madras, of Mr. V. S. Sambasiva Iyer, retired Professor of Geology, Central College, Bangalore. After passing the B.Sc. and L.C.E. examinations of the Bombay University, Mr. Sambasiva Iyer joined the Mysore Geological Department as one of the Probationers and soon rose to the position of Assistant Geologist. He was appointed Professor of Geology in the Central College in the year 1914, which post he held till his retirement in 1920. Even after his retirement from official service he continued to be an active field geologist and took a prominent part in the development of the mineral resources of South India. By his pleasant and amiable disposition and his unostentatious and simple habits, he had endeared himself to all his students, friends and colleagues alike.

RESEARCH PAYS

RESEARCH pays in hard, cold cash, Eugene Ayres of the Gulf Research and Development Company told the meeting of the American Chemical Society recently. He explained a numerical yardstick which he has developed, which gives an estimate of the differences in costs between industrial processes put into operation without waiting for preliminary experimentation and those that are given the benefit of research in laboratory and pilot plant, together with proper patent procedures, before they are started. If a given industrial problem is carried through all three steps of research, patent procedures and pilot plant experiments, the total cost of "make-ready" is considerably less than half that involved in rushing into full production without the preliminary steps. How necessary the pilot-plant stage is also shown up in the table. With laboratory research and patent procedure, but omitting pilot plant the costs were substantially greater than those of complete preparation, though still substantially less than those of no preparation at all. Mr. Ayres cited the case of a company that found it necessary to go into the manufacture of a new chemical in a hurry: "There were no large-scale precedents for this operation, but two good process ideas were offered by the Research Department. Because of the emergency, it was decided to commercialise one idea without any research while the second idea was carried in orderly fashion through laboratory and pilot plant. Despite the delay occasioned by months of research, the second idea resulted in a smoothly operating plant before the first and at much lower development cost. The first idea was then sent back to the Research Laboratory and a year later superseded the second."—FRANK THONE.

(Courtesy of *Science*, 1942, 96, 14.)

LETTERS TO THE EDITOR

EFFECT OF HIGH-FREQUENCY VOLTAGE ON DIELECTRIC CONSTANT OF SPACE CONTAINING ELECTRONS

PRASAD AND VERMA[1] while investigating the applicability of Eccles-Larmor expression for the dielectric constant of electronic medium inside a Phillip A 442 Valve observed that the dielectric constant of such a medium depended upon the magnitude of the impressed high-frequency voltage, the anode and the screen-grid of the valve forming the plates of the experimental condensor. They observed that there was a parabolic relation between the change of capacity of the experimental condensor and the magnitude of the high-frequency voltage. Khastgir and Choudhury[2] also noticed this dependence, but did not confirm this parabolic relationship. Khastgir suggested that the observed effect was due to the fact that the effect of high-frequency voltage is to alter the amplitude of the electrons in the anode screen-grid space. For smaller values of voltage, electrons may not be able to reach the anode surface and for such conditions the conductivity of the space must be small and hence the equivalent shunt resistance high. With the increase of high-frequency voltage, this resistance would gradually fall and after some time, it will come to a constant value. As the effective change of capacity depends upon the conductivity of the space, the variation of the latter will explain the experimental results.

The present work was undertaken to study the subject in greater detail with a view to clarify the exact reason leading to this dependence. This was considered desirable specially in view of the fact that there is no room for the magnitude of high-frequency voltage in Eccles-Larmor expression. The present author has repeated the experiments of Prasad and Verma by using the same method with some improvements taking into account conductivity corrections. He has not been able to obtain any parabolic variation and the experimental curves obtained by him are essentially of the same type as those obtained by Khastgir and Choudhury. One typical graph is given in Fig. 1.

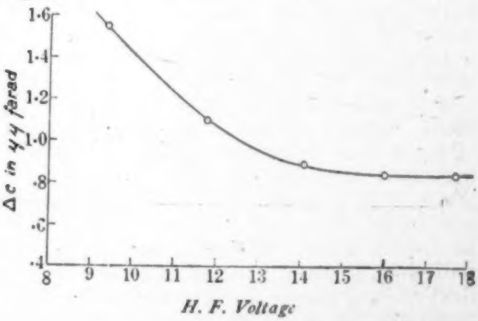

FIG. 1

λ - 110 metres. $i = 125 \times 10^{-6}$ amp.

Phillips B 442 valve

It is noticed that the anode current alters with the change in the magnitude of the high-

frequency voltage. As the high-frequency voltage gradually increases, the anode current also gradually increases until a stage comes when there is no further change in the current with the increase of high-frequency voltage. The nature of variation is shown in the graph given in Fig. 2.

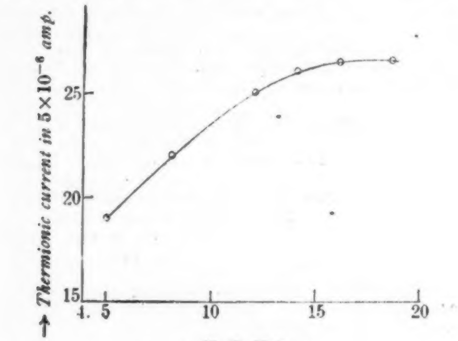

FIG. 2

Variation of Thermionic current with H. F. Voltage

Thus it seems likely that there is no dependence of dielectric constant on the high-frequency voltage, but the effect observed is of a secondary nature. The high-frequency voltage alters the magnitude of the anode current, but in our experiments and those of previous workers, the anode current was maintained constant by altering only the filament resistance. This procedure certainly altered the effective value of the electronic concentration between the condensor plates. This fact is further strengthened by the observation that the thermionic current begins to assume constant value at that high-frequency voltage where the change of capacity tends to become constant (compare Fig. 1 and Fig. 2).

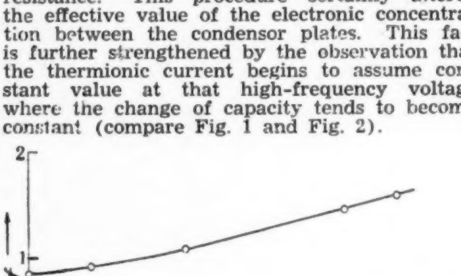

FIG. 3

Change in Thermionic current (in 5×10^{-8} amp.) due to application of H. F. Voltage

To bring out the relationship more clearly Fig. 3 has been drawn between the change of thermionic current due to impressed High Frequency Voltage and the change of capacity observed. The figure reveals that at least partially the observed change in capacity is due to change in electronic concentration consequent upon the introduction of High Frequency Voltage.

In conclusion the author thanks the Government of Bihar for the kind award of a scholarship during the tenure of which this piece of work was undertaken. The author is also thankful to Prof. S. P. Prasad and Dr. B. N. Singh for constant help and guidance throughout the investigation.

Physics Laboratory,
Science College, Patna,
January 1, 1943.

SNEHMOY GHOSH.

1. Prasad and Verma, *Zeits. f. Physik.*, Band **99**, **7** and 8 heft, **107**. 2. Khastgir and Choudhury, *Indian Journal of Physics*, **1940**, **14**.

THE RARE OCCURRENCE OF MELILITE-DIOPSIDE-NEPHELINE ASSOCIATION IN A CALCIPHYRE, NEAR NANJANGUD, MYSORE

IN my present detailed studies of the Charnockite rocks in Mysore, while re-examining the micro-sections of some specimens of re-crystallised calc-granulites (Caliphyres) I had collected near Nanjangud* in 1923, I recently noticed in one of them a mineral—which, from its optical characters and micro-chemical tests —I recognise as Melilite. A careful examination of the several specimens I had previously collected in the area discloses that Melilites, of varying optical characters, occur in a narrow band of garnetiferous-hornblende diopside granulite,—a component of a thin composite series of calc-granulites which are injected and veined by a later set of pegmatite. Melilites—presumably of varying composition—where found, are intimately associated with diopside, or zoisite and epidote; and are seen either as separate stout laths or in intergrowth with the one or the other of its associated minerals. One of the specimens of these granulites discloses in addition, large plates of nepheline enclosing, poikilitically, several coarse grains of diopside and granular sphene. Scapolite, lime, alumina, garnet, sphene, epidote, and some unidentified rare types of lime silicate minerals are also found in some of the specimens of highly calciferous types.

The occurrence of Melilite and Nepheline in these Calciphyres, is not only of great interest as the first recorded discovery of these minerals in Mysore, but their close association with diopside would throw some light on their paragenesis and on the mode of origin of the melilite rocks which, at least so far as this area is concerned, seem to have been formed from re-actions between an older impure dolomitic limestone and the later injected alkalic liquids connected with the granitic intrusions of the region. A full description of these melilite-bearing rocks, which are still under a detailed study, will be given in Volume XLI, *Records of the Mysore Geological Department*, which will be published in the course of a few months.

Mysore Geological Dept.,
Bangalore,
January 27, 1943.

B. RAMA RAO.

A NOTE ON THE WIND-BORNE DUST COLLECTED IN THE MONTH OF MAY 1942

DUST STORMS had been particularly heavy in Delhi in May 1942 and a deposit during the last week, on a 20 cm. × 20 cm. glass plate weighed 12·45 gm. with an apparent volume of 11·3 c.c. The sample was collected and subjected to chemical and mechanical analyses. It was seen from the results that the dust had been mainly sand with a small amount of clay and had very little organic matter. The chemical composition suggested that the dust was soil from an extremely arid zone:—

Mechanical analysis: Coarse sand—31·92%, Very fine sand—53·00%, Silt—13·34%. Clay—2·74%.

Chemical analysis: Insoluble residue—84·83%. Fe_2O_3—4·21%, Al_2O_3—4·06%, CaO—1·43%, MgO—1·12%, K_2O—0·66%, Na_2O—1·20%, Organic matter—0·64%.

pH of the dust as determined colorimetrically was 8·2. Analysis of the water extract (1:5) suggested the following percentage composition for the mixture of soluble salts. Total salts—0·2000, $CaCO_3$—0·0025, $Ca(HCO_3)_2$—0·0689, $CaSO_4$—0·0238, $MgSO_4$—0·0142, NaCl—0·0846.

Dust collected at different periods during summer of 1942 had practically the same mechanical composition. Chemical analyses were not carried out. The sample of dust was very similar to the so-called "dust soils" of the arid regions of the United States of America and examined by Hilgard.* These soils have been described to be "so loose and fine as to rise in clouds at the merest puff of wind", during the dry season.

My thanks are due to Dr. S. V. Desai and Mr. A. C. Ukil for many valuable suggestions.

Imperial Agric. Res. Institute,
New Delhi, ABHISWAR SEN.
February 3, 1943.

* Bull. No. 3, Weather Bureau, U.S. Dept. of Agriculture, 1892, quoted in *A Treatise of Rocks, Rock Weathering* and *Soils*, 1897, 345, by G. P. Merrill.

*REPORT ON THE OCCURRENCE OF *SIREMBO IMBERBIS* TEM. AND SCHL.,[1] FROM INDIAN WATERS TOGETHER WITH A NOTE ON ITS PYLORIC CÆCA

WHILE working on the pyloric cæca of Indian fishes, I came across a Brotulid fish in the general collection of the Biological Station (Ennur), Madras Fisheries Department. As the fish was quite new to me and also as I was unable to identify it owing to lack of literature, it was sent to Dr. J. R. Norman of the British Museum, who identified it as *Sirembo imberbis* Tem. & Schl.[2] He also pointed out that it has been reported from Japan and once from Chinese waters, and is a deep sea fish; there was no report of its occurrence in the Indian waters. The last statement was corroborated by Dr. Hora also.

As is well known, Madras fishermen on the east coast (Bay of Bengal) use catamarans and do not go very far out for catching fish, the utmost limit being ten miles from the shore and depth twenty fathoms; thus they fish in comparatively shallow waters only. For the Biological Station at Ennur, the fishes are collected from the catches of the fishermen and preserved. The fish under report must have belonged to such a general collection and was, therefore, not caught from deep waters. From the number of specimens examined by me in the collection of the Biological Station, the fish does not appear to be very rare in these waters.

I have examined and dissected a dozen fishes and note below the colouration of specimens preserved in formalin:—

Dorsal surface and sides brown, with four to five dark-brown longitudinal bands on the sides running more or less parallel to one another. Ventral side slightly brown. Dorsal fin with two black and three brownish-black spots on the margin not reaching the base; rest of the dorsal and anal have a blackish margin. Pectoral brownish, without black fringe.

The number of pyloric cæca varies from 13 to 15, but usually the number is fifteen. They are bilaterally arranged in linear series, *i.e.*, on the right and left of the proximal part of the duodenum immediately after the pylorus, and have independent and separate openings into the former, usually six cæca being present on the right and nine on the left side. They are tubular structures somewhat tapering towards their free ends (Text-Fig. 1).

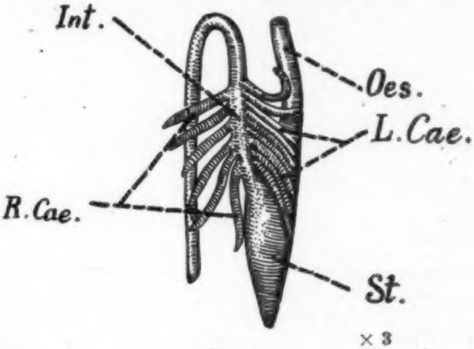

FIG. 1

Viscera of *Sirembo imberbis* Tem. and Schl., showing the disposition of the cæca

Oes.—Oesophagus; *L.Ca.*—Cæca of the left side; *St.*—Stomach; *R.Ca.*—Cæca of the reght side; *Int.*—Intestine.

I am greatly indebted to Dr. B. Sundra Raj and Dr. D. W. Devanesan for affording me an opportunity of working on this fish. For the

* A detailed note on the systematic position and its distribution will be published by Dr. B. Sundra Raj

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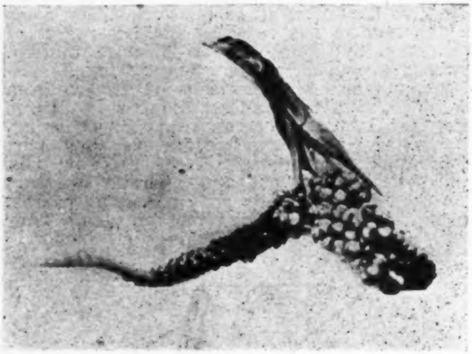
identification of the material, I am grateful to Dr. J. R. Norman of the British Museum and to Dr. S. L. Hora of the Department of Fisheries, Bengal, for the supply of literature.

Department of Fisheries,
H.E.H. the Nizam's Government,
Hyderabad (Dn.), M. RAHIMULLAH.
January 1, 1943.

1. Norman, J. R., "The John Murray Expedition, 1933–34" *Scientific Reports*, 1939, 7, No. 1. 2. Gunther, A., *Cat. Fish. Brit. Mus.*, 1862, 4, 373.

A NOTE ON *BORASSUS FLABELLIFER* LINN.

Borassus flabellifer Linn. is described as a tall diœcious palm in systematic accounts.[1] Blatter[2] describes it as a "very tall diœcious palm" and does not refer to any exceptions. But monœcious trees of *Borassus* seem to be common. The monœcious inflorescences are observed to be produced by some trees regularly year by year. The photograph published is that of



Monœci.s spa ix of *Borassus flabellifer* Linn.

such an inflorescence, observed by the writer, where one branch of the spadix (right) bears only female flowers and the other (left) bears female flowers at the base and male flowers towards the tip, where the branch shows a deflection.

The unisexual condition in this genus seems to be derived by reduction from hermaphrodite flowers, the female flowers containing 6-9 staminodes and the male flowers containing a pistillode represented by three bristles.

Botany Department,
P. R. College, Cocanada, V. VENKATESWARLU.
January 14, 1943.

1. Hooker, J. D. Sir, *The Flora of British India*, 1894, 6. 2. E. Blatter, S.J., "The Palms of British India and Ceylon, Indigenous and Introduced, Part VII," *The Journal of the Bombay Natural History Society*, 1912, 21, No. 3.

EXCITATION AND ACCOMMODATION IN UNSTRIATED MUSCLE

WHEN unstriated muscle is stimulated with alternating current (A.C.), the tension soon subsides owing to accommodation (Singh, 1938).

This phenomenon is analogous to that described by Hill (1936) in nerve. Using his terminology the tension subsides when "U" rises above "V", their rise being visualised as in Fig. 1. When the muscle is stimulated with A.C., two factors produce their effects, one that retards relaxation, and the other that produces tension. These two factors are not the same, as shown by the fact that the muscle accommodates to the two at different times; the two factors are antagonistic. Using 8 volts, A.C., the relaxation is retarded if the duration of the contraction is approximately less than 3-4 seconds; accommodation to tension takes longer, about 5-7 seconds. The primary tension is probably produced by ions inside, and retardation of relaxation by ions; outside (Singh, 1938,[3,4,5,6,7,8] Singh, 1939,[9,10] Singh

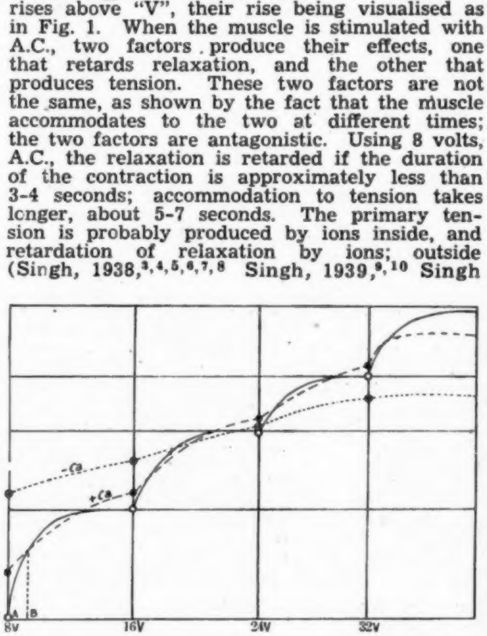


FIG. 1. Unstriated muscle. Rise of "V" (continuous line) and rise of "U" (discontinuous lines) In the absence of calcium the initial threshold rises but the rate of rise is less (Singh, 1938*d*). Ultimately "U" may begin to fall, owing to "adaptation to adaptation" or "accommodation to accommodation".

1940,[12 13]; Singh, 1942, 1943,[14,15] Rao and Singh, 1940). The above results show that "U" rises more slowly than "V".

When the stimulus is over, fatigue persists to A.C., and potassium for sometime, and tone also is neutralised for 3-4 secs. This shows that the fall of "U" is slower than that of "V"; the primary tension is probably produced by ions inside and tone and the potassium contraction by ions outside.

The interval from A to B, that is, the latent period, is the time required by "V" to catch "U" as suggested by the fact that potassium and magnesium which increase accommodation in nerve, increase the latent period of certain contractions in Mytilus muscle.

Ultimately "V" rises higher than "U" as shown by the fact that with higher voltages continuous tension is produced, and the rate

of relaxation is decreased. Ultimately, however, "U" may fall owing to "accommodation to accommodation" or "adaptation to adaptation".

Brigade Laboratory,
Allahabad, INDERJIT SINGH.
January 18, 1943.

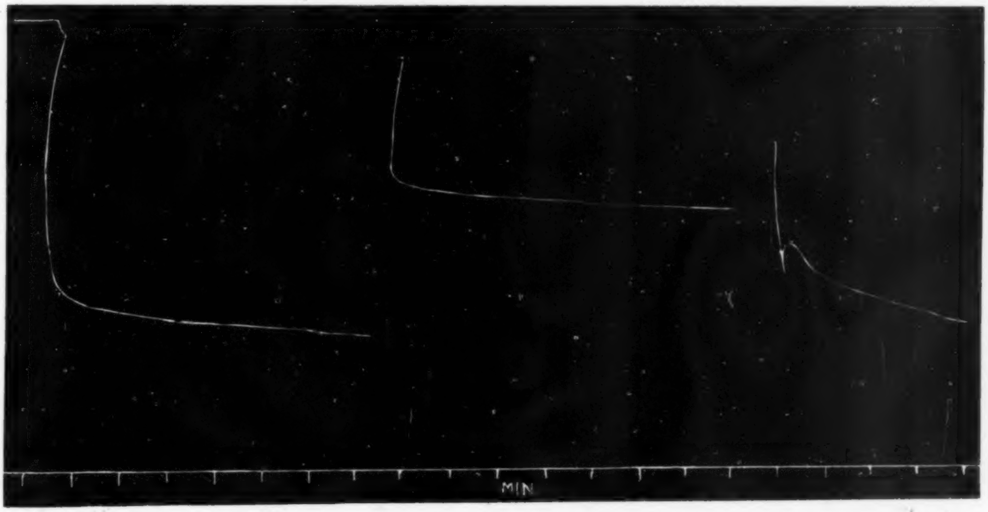
1. Hill, A. V., *Proc. R. Soc.* 2. Rao, M. S., and Singh, I., *J. Physiol.*, 1940, **98**, 12. 3. Singh, I., *Ibid.*, 1938, **91**, 398. 4. *Ibid.*, 1938, **92**, 62. 5. *Ibid.*, 1938, **92**, 232. 6. *Ibid.*, 1938, **94**, 241. 7. *Ibid.*, 1928, **94**, 1. 8. *Ibid.*, 1938, **96**, 367. 9. *Ibid.*, 1939 **96**, 1. 10. *Ibid.*, 1939, **96**, 367. 11. *Ibid.*, 1940, **98**, 155, 12. *Ind. J. Med. Res.*, 1942, **30**, 449. 13. *Ibid.*, In the Press. 14. *Proc. Ind. Acad. Sci.*, 1943, In the Press. 15. *Ibid.*, In the Press.

THE CONTRACTION OF UNSTRIATED MUSCLE PRODUCED BY CHANGE OF TENSION

UNSTRIATED muscle is known to contract on sudden increase of length (Straub, 1900; Winkler, 1898; Singh, 1938). Singh (1938) has shown that unstriated muscle not only responds to increase but also decrease of tension or length, so that like other stimuli, it is the change of state that excites the muscle. Further this contraction has properties of the potassium contraction.

The contraction produced on stretch has been ascribed to nervous activity (Ferguson, 1942). I am not inclined to agree to this, as the potassium contraction is increased by agencies that paralyse nerves, such as, chloral hydrate, ether, curare, novocaine, nicotine. Fig. 1 shows stretch contraction produced in the presence of 0·1 per cent. nicotine. When I first noticed the stretch response in Mytilus muscle, I thought it was due to nervous activity, so I used chloral hydrate to abolish it, but I found that the latter augmented the response.

The absence of the stretch response in nerve-free smooth muscle is no indication that it is produced by nerves. It is not always found in Mytilus muscle, and I have not found it in frog stomach which contains nerves. Its presence depends on the action of ions outside, and also on the rate of stretching. Calcium increases this accommodation in Mytilus muscle. The fact that contraction is produced both by stretch and release suggests that it is due to a certain configuration of the myosin molecule through which the muscle passes as its length is changed either way, this configuration being distorted by accommodation. Changing the length of the molecule probably produces orientation of the bonds, so that the molecule becomes polarised, and difference in potential is produced between parts of the molecule.



The effect of nicotine (0·1 p.c.) on the stretch response

Curve I in Mytilus saline

Curve II in Acetylcholine (1 in 10^5)

Curve III in Acetylcholine + nicotine. Note the stretch response.

Brigade Laboratory,
Allahabad, INDERJIT SINGH.
January 18, 1943.

1. Ferguson, J., *Amer. J. Physiol.*, 1942, **131**, 524. 2. Singh, I., *J. Physiol.*, 1938, **92**, 62. 3. Straub, W., *P. Fluger's Arch.*, 1900, **79**, 379. 4. Winkler, H., *P. Fluger's Arch.*, 1898, **71**, 357.

A NOTE ON THE OIL FROM THE FRUIT OF *BALANITES ROXBURGHI*

Balanites Roxburghi (N.O. Simarubeæ) is a small thorny tree whose seeds, bark and leaves are used as indigenous drugs [*vide* (*i*) *The India Materia Medica*, by K. M. Nadkarni, p. 97; (*ii*) *Nighantu Adarsha*, by Vaidya Bapalal Garbaddas Shah, p. 225; (*iii*) *Dictionary of the Economic Products of India*, by Watts, Vol. I, p. 363].

The fruit of this tree is oval, of a yellowish colour (when ripened), composed of a sweet but disagreeable pulp surrounding the stone. The pericarp content of the fruits is about 30 per cent. The remaining stone consists of seed kernel and a stout shell which is largely employed in the preparation of indigenous fireworks. The kernels of the seeds on extraction with petroleum ether yield about 43 per cent. oil of an almost yellowish colour. The oil has a faint odour and shows the following characteristics.

Refractive Index at 40° C. = 1·4623, Saponification value = 195·20, Acid value = 0·575, Acetyl value = 31·75, Iodine value (Wiji's method) = 88·30, Unsaponifiable matter = 2·92.

The examination of the component fatty acids of the oil is in progress.

The pericarp of the fruit which is used as a detergent to clean silk and cotton textiles yields profuse lather and is under investigation.

Industrial Chemist's Laboratory,
Sayaji Technological Institute, C. B. PATEL.
Baroda,
January 20, 1943.

CHEMICAL INVESTIGATION OF HAIRS FROM THE MEDICO-LEGAL STANDPOINT

THE examination of hairs and fibres upon weapons, in blood or other stains, upon the clothing or person of the victim or assailant or at the scene of a crime is of great medico-legal importance, for by such investigations significant clues may be discovered and definite links in a chain of evidence may be established. The first point which an expert has to decide is whether the particular hair is human hair or that of a particular animal. At present, opinion on the point is given only on the basis of microscopical examination. One has to rely mainly on the anatomical characters of the various parts of hairs, *i.e.*, on the size and appearance of the medulla, cortex and cuticle. It was, therefore, thought desirable to discover some independent method for distinguishing between hairs of different animals. Exploratory experiments with about thirty different reagents were tried and it was found that the action of (1) chlorosulphonic acid, (2) nitric acid, (3) 5 per cent. solution of potassium dichromate and (4) caustic alkalis, is of diagnostic value.

Before microscopical examination, hairs must be cleansed. Hairs smeared with blood, etc., are best cleansed by treating them first with 5 per cent. potassium cyanide solution, followed by water and alcohol-ether mixture. The structures of thick or dark hairs are best brought out by the action of 5 per cent. potassium dichromate solution (in acid medium) or strong nitric acid. Nitric acid is quicker in action and generally clarifies the structure in about five minutes, but it has also a dissolving action. Five per cent. dichromate solution, although slower in action, is of greater diagnostic value—the hairs of different animals requiring different times for decolourisation, the time taken depending upon the colour and thickness of the hair. Details of these experiments will be published elsewhere.

The above two reagents were found to be much superior clearing agents than hydrogen peroxide, which is usually used for this purpose.

Attempts were made to discover (1) such reagents as would dissolve some animal hairs, but not others, (2) reagents which would take different times in dissolving hairs of different animals, (3) reagents which would gelatinise or disintegrate different hairs in different times. *Chlorosulphonic acid* disintegrates the hairs, the action starting first with the cuticular scales. These scales swell up, the cuticular and medullary pigment getting decolourised. Prolonged treatment completely disintegrates the hairs into cuticular and medullary fragments. It was found that the hairs of the horses, goats and pigs require longer time for complete disintegration than the hairs of other common animals. *Caustic alkalis* gelatinise the hairs and dissolve them in a short time. They soften the hairs even in the cold and hence a preliminary treatment with 10 per cent. caustic soda solution in the cold for about ten minutes is very helpful in taking cross-sections of the hairs. With 20 per cent. caustic potash solution, the time taken for complete gelatinisation of the hairs varied from half minute to three minutes and the time taken for complete dissolution varied from four to ten minutes.

A detailed account of the action of the various reagents on hairs of different animals and an account of the investigations on the effect of age on hair is reserved for a future communication.

Chemical Examiner's
Laboratory, Agra, S. N. CHAKRAVARTI.
September 14, 1942. S. N. ROY.

REVERSED POLARITY IN THE EMBRYO-SAC OF *HEPTAPLEURUM VENULOSUM* SEEM

CASES of reversed polarity in the embryo-sacs are rare. Schnarf[1] (1931) refers to only four cases, (1) *Rhopalocnemis phalloides* (Lotsy, 1901), (2) *Lindelofia longiflora* (Svensson, 1925), (3) *Fuchsia marinka* (Tackholm, 1915) and (4) *Atamasco texana* (Pace, 1913). Three more cases have recently been added from India to the list of such forms. Dutt and Subba Rao[2] (1933) recorded a probable case of embryo-sac reversal in *Saccharum*. Joshi and Venkateswaralu[3] (1935) noticed a single case of embryo-sac reversal in *Woodfordia*

floribunda collected near Kumaon. Thirumalachar and Basheer Ahmad Khan[4] (1941) recorded the same feature in *Eriodendron anfructosum*.

During the course of embryological studies on the Araliaceæ the author noticed a single case of embryo-sac reversal in *Heptapleurum venulosum* Seem, which is an interesting record for that family. The egg apparatus was situated at the chalazal end, the synergids showing prominent basal vacuoles. The antipodals are

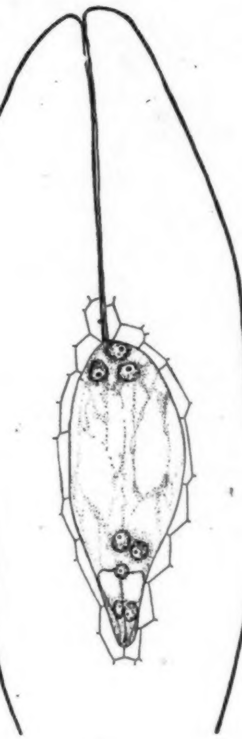


Fig. 1

Showing reversed polarity of the embryo-sac. × 570

sometimes cellular, in normal cases, situated in a chalazal pouch. In the embryo-sac with reversed polarity, the egg apparatus was organised in the chalazal pouch. The three nuclei at the micropylar end remained as such without becoming cellular.

Joshi and Venkateswaralu (1935) in their account of the embryo-sac reversal in *Woodfordia floribunda* state that it was the first clear case of reversed polarity observed in an eight-nucleate embryo-sac. In *Lindelofia longiflora* where Svensson records reversed polarity, the antipodals were absent. In *Eriodendron anfructosum* also the antipodals show early degeneration. The lack of antipodals in these forms due to early degeneration which is characteristic of the form should not preclude them from being recognised as normal eight-nucleate embryo-sacs. Only in *Atomasco texana* appreciable numbers of embryo-sac reversals are known, and the single cases noticed in *Woodfordia*, *Eriodendron*, *Heptapleurum* and others are abnormalities probably without any significance.

Thanks are due to Dr. L. N. Rao for his guidance.

Bangalore,
January 10, 1943. D. M. Gopinath.

1. Schnarf. K., *Vergleichende Embryologie der Angiospermen*, 1931. 2. Dutt, N. L., and Subba Rao, *Ind. Jour. Agri. Sci.*, 1933, **3**, 37–56. 3. Joshi, A. C., and Venkateswaralu, J., *Ann. Bot.*, 1935, **59**, 841–43. 4. Thirumalachar, M. J., and Basheer Ahmad Khan, K. *Proc. Ind. Acad. Sci.*, 1941, **14**, 461–65.

SPORE-GERMINATION OF *GANODERMA LUCIDUM* (LEYSS.) KARST.

Ganoderma lucidum (Leyss.) Karst. is a cosmopolitan species, growing as a saprophyte as well as a wound-parasite on a large number of hosts. After repeated attempts Coleman[1] in 1927 failed to germinate the spores, and believed that the failure might be due to chitinous endospore. Bose[2] in 1929 successfully germinated the spores in malt-extract agar medium (3 per cent. malt-extract, 2 per cent. agar and 100 c.c. dist. water, pH 6·9). Venkatarayan[3] subsequently in 1936 failed to germinate the spores, though he tried a number of media.

It is now found that spores germinate easily in 3 per cent. and 2 per cent. malt-extract agar medium. For this purpose sporophores were collected from Calcutta on 16th September, 7th October and 21st November 1942. The sporophore was separated from the substratum carefully without touching the hymenial surface, and was kept as a whole without sectioning, above the agar-floor of a sterilised agar plate by means of three glass rings. A number of mature brown spores was thrown on the next day in each case. The spore fall continued for two days. The spores were aseptically transferred to malt-extract agar tubes (2 per cent. malt-extract, 2·5 per cent. agar and 100 c.c. dist. water, pH 6·8), where they are growing normally; the hyphæ are hyaline, branched and septed, the septa showing a good number of clamp-connections. During this period the room-temperature varied from 32° to 20° C. and the relative humidity, from 98 to 52 per cent.

It was found that in laboratory conditions the sporophores discharged spores for 1 to 2 days only. Field observations for a number of years indicate that in *Ganoderma lucidum* the spore fall is usualy abundant when the colour of the hymenial surface is grey and moist, the spore fall becomes less when the colour is changed to white and it usually stops when the colour turns brownish. In a private communication to Dr. S. R. Bose dated 30th May 1932, E. J. H. Corner of the Singapur

Botanic Garden wrote that *Ganoderma* sporophores throw out spores only when they are well-grown with their tubes 1 cm. or more long. But in these specimens of *G. lucidium* the sporophores had tubes only 2-3 mm. long.

This work was carried out by me as Kirtikar Research scholar of the Calcutta University in the Botanical Laboratory of the Carmichael Medical College, under the direction of Dr. S. R. Bose, Professor of Botany.

Calcutta,
December 18, 1942. SUBODH KUMAR SENGUPTA.

1. Coleman, L. C., "Structure of spore wall in *Ganoderma*," *Bot. Gaz.*, **1927**, **83**, 48–60. 2. Bose, S. R., "Artificial culture of *Ganoderma lucidus* (Leyss.) from spore to spore," *Ibid.*, **1929**, **87**, 665–67. 3. Venkatarayan, S. V., "The Biology of *Ganoderma lucidum* on Areca cocoanut palms," *Phytopathology*, **1936**, **26**, 153–175.

A NOTE ON THE NESTING HABITS OF THE OLIVE LOGGER-HEAD TURTLE, *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ) AT KRUSADAI ISLAND*

THREE species of turtles, namely, the Green Turtle *Chelonia mydas* (Linne), the Olive Logger-head Turtle *Lepidochelys olivacea* (Eschscholtz) and the Hawksbill Turtle *Eretmochelys imbricata* (Linne) occur in the sea around Krusadai Island. The edible Green Turtle is common but curiously enough it does not nest on the Island. The Hawksbill Turtle is very rare in its occurrence. The Olive Logger-head Turtle is just as common as the Green Turtle. There is a fishery of the Logger-head Turtle in the coastal villages of the Gulf of Manaar.

Nesting: That of the Logger-head Turtle alone on the sandy coast of Krusadai Island

Date	Phases of the Moon	Date on which nests were located	Number of nests
20-10-41	New Moon	18-10-41	1
4-11-41	Full Moon	2-11-41 & 7-11-41	2
19-11-41	New Moon	17-11-41	1
3-12-41	Full Moon	3-12-41	1
18-12-41	New Moon	16-12-41&21-12-41	3
2- 1-42	Full Moon	30-12-41, 2- 1-42 & 4- 1-42	3
16- 1-42	New Moon	16- 1-42	1
1- 2-42	Full Moon	1- 1-42	2
15- 2-42	New Moon	17- 2-42	1
3- 3-42	Full Moon	5- 3-42	1
16- 3-42	New Moon	—	—
1- 4-42	Full Moon	1- 4-42	1
15- 4-42	New Moon	18- 4-42	1
		Total number of nests	18

came under my observation. Altogether eighteen nests were examined. There seems to be a lunar periodicity in the act of oviposition as will be evident from the above table.

The nest is but a simple burrow dug out in the sand above and away from the high water-mark. The distance between the high water-mark and the burrow varies from 6 to 30 feet. The burrow is about 1½ ft. wide at the bottom and 1 ft. wide at the top and 2 ft. deep. The long axis of the burrow forms an acute angle with the surface-level axis of the ground and its blind pocket is turned away from the sea. Thanks to the maternal instinct of the mother-turtle to hide all traces of the packing of her eggs in the burrow, she bites off pieces of plants found in the neighbourhood, such as Ravana's moustache, *Spinifex squarrosus*, the herb, *Launea pinnatifida* and the Ground-Glory, *Ipomea biloba* which grow wild in the Island, and covers the top of the burrow.* For one or two days immediately after nesting, the nest can be easily spotted by the trail of the mother-turtle and the damp soil of the now closed external orifice of the burrow. The nesting season commences in October of one year and ends in April of the following year—*vide* table.

Eggs: The number of eggs in a nest ranges from 90 to 125. The eggs are spherical and their diameter varies from 36 to 39 mm. The shell is leathery. The eggs are packed in the blind pocket of the burrow to a height of 1 ft.

Incubation: Eggs removed from the nests and buried in pits 1½ ft. to 2 ft. deep, dug near the Laboratory, hatch. The period of incubation is from 54 to 56 days. The embryos after hatching out remain in the nest from 4 to 6 days. Subsequent daily observations revealed that the hatched young ones worked their way upwards to the surface at the rate of 2 to 3 inches a day. Finally they reach the surface on the 4th, 5th or 6th day after hatching, and toddle towards the sea, on entering which they paddle away unaided. The axis of exit follows the slanting long axis of the burrow scooped out by the mother-turtle as well as the vertical long axis of the pit dug artificially, thus indicating that the young ones are guided only by the looseness of the sand packed.

Economic Aspect: Turtle-nest hunting is seldom practised and consequently, the percentage of young ones added annually to the existing stock of Logger-head Turtle population must be considerable. This perhaps partly explains the abundance of this turtle in the sea of Krusadai. In Ceylon, the eggs of this turtle are sold in fish-markets, whereas in the maritime villages near Krusadai, they are only occasionally eaten by turtle catchers and, therefore, do not extend into general consumption, another factor which doubtless contributes to

* Published with the permission of the Director of Industries and Commerce, Madras.

* Deraniyagala who has observed the nesting habits of the same turtle in Ceylon does not record this detail. For other differences between his description and mine, the reader may refer to pp. 154–55 of "The Tetrapod Reptiles of Ceylon," Vol. I, by P. E. P. Deraniyagala.

their abundance in the seas around Krusadai. Crude oil is extracted by fishermen from the flesh of this turtle and is used by them for smearing country-crafts. The determination of the nesting season and a study of its nesting habits have, therefore, a bearing on the protection of this turtle-fishery, should such a need arise in the future.

Krusadai Biological Station,
Pamban P.O., P. I. CHACKO.
December 9, 1942.

ON THE MANUFACTURE OF GLANDULAR PRODUCTS IN INDIA

THE recent note[1] by Prof. Dey on the preparation of adrenalin from suprarenal glands is of interest to those who are associated with the manufacture of adrenalin hydrochloride solution in India. In a previous note[2] it was recorded that the total amount of adrenalin that might be produced from natural resources would barely exceed 100 ounces; whereas Dr. Dey now on the authority of the Board of Scientific and Industrial Research mentions that the mobilisation of the raw materials from the slaughter houses of only ten of our large cities might lead to the production of sufficient adrenalin to meet the demands of civilian population and the military requirements. But Prof. Dey has not pointed out his method of extraction, nor the exact yield of adrenalin per 100 glands as collected from the local slaughter houses. In handling thousands of glands we are finding that the average weight of a suprarenal gland comes to about 4·8 to 5·0 gm., and the yield of pure adrenalin per 100 of such glands varies from 0·1 to 0·12 gm. This figure is about 25 per cent. lower than what is being recorded in some standard books[4] where the yield is shown to be 0·13 to 0·16 gm. per 100 glands. Of course it is not known to us whether this low yield is due to any defect in our technique of extraction, collection of glands or to some inherent drawback in the nature of glands themselves.

It must, however, be noted as already recorded by Dey[3] that adrenalin being a hormone of emergency may be excreted out into the circulatory system of the animals when they are brought to the abattoirs as existing in the present state. In connection with our work on the posterior pituitary lobes we also find that although the powder that is finally obtained by drying the fresh lobes collected from the local slaughter house possesses the same potency as what is being noted in a similar powder secured from reputed firms in the Western countries, the yield in dry powder is again about 40 per cent. less than that recorded by workers abroad. Thus, in isolating the physiological principles whether from suprarenals, gall bladders, pituitary lobes, or any other gland, the purity of the product is beyond question, but the yield on the amount of the active principle is invariably poor. The problem is how to increase this yield. The method of slaughtering is to be altered and the abattoirs are to be improved. The solution, however, seems mainly to remain in melioration of the breed and class of animals that are being daily brought down to the slaughter houses for supplying the meat requirements of the cities.

Bengal Immunity Research
Laboratory, Calcutta. U. P. BASU.
January 15, 1943.

1. This Journal, 1942, 11, 444. 2. *Ibid.*, p. 290. 3. *Ibid.*, p. 420. 4. *Cf.*, Fourneau, *Organic Medicaments and Their Preparations* (J. & A. Churchill), 1925, p. 230.

I HAVE read with much interest the note sent by Dr. Basu on the manufacture of glandular products in India. Full details of experiments regarding methods of extraction, and exact figures relating to yields of products at different stages, could not be disclosed in the publications which have appeared from time to time from this laboratory, as the investigations were being carried out under the auspices of the Board of Scientific and Industrial Research who possessed all the rights over the results. The publications were intended principally to focus attention on what seemed to be a topic of great public interest, and I am glad to note that this purpose is being achieved to a great extent.

Without any fear of infringing on the rights of the Board, it may be stated definitely that the yields of adrenaline obtained in this laboratory, have been considerably higher than those reported by the writer. An important reference appears also to have been misquoted: The yield obtained by Fourneau is 0·13 to 0·16 gm. per 100 grams of gland material and not per 100 glands. The weights too of the glands mentioned—4·8 to 5 gm.—make it obvious that only glands of cattle are referred to; the glands of sheep have been left out of the calculation. Several thousands of these animals, however, are being slaughtered daily in our cities, and although the sheep glands are much smaller than those of cattle, they must, by sheer weight of numbers, inevitably constitute the major bulk of the raw material for these products.

The statement that the yield of active principles from the glands of Indian animals is invariably poor is also not always borne out by experience. In the brief review of the technical work of the Board of Scientific and Industrial Research, published in your *Journal* (1942, p. 171), it was pointed out that desiccated Thyroid, as prepared in Madras, is considerably richer in Thyroxin-Iodine than the specimens imported from abroad. In the case also of the Pituitary, although the net weight of the whole gland is smaller, there is a special feature of the Indian animal gland which has been found to make up to some extent for its deficiency in weight.

I may take this opportunity to point out that further statistics, which have now been made available by the Board, confirm our original belief that, as in the case of adrenaline so also in the case of posterior pituitary extracts, India could supply all her requirements.

Presidency College,
Madras, B. B. DEY.
February 4, 1943.

REVIEWS

A New Physical Chemistry*

Physical Chemistry may be defined as a consideration and interpretation of the facts of chemistry in the light of physical principles. An exposition of the relevant physical principles followed by an application of the same to specific chemical themes should accordingly form the plan of any rational treatise on the subject. The kinetic theory of gases and the principles of thermodynamics formed the common ground between physics and chemistry till some two or three decades ago. The remarkable developments which have taken place of recent years in atomic physics have, however, tended to bring physics and chemistry into much closer union at the present time. We may specially mention here the interpretation of atomic structure on the basis of the spectroscopic evidence, the elucidation of molecular structure by studies on band-spectra, infra-red absorption and light scattering, and the analysis of crystal structure by studies on X-ray and electron diffraction. The development of the new quantum mechanics has also made possible an understanding of the nature of the atomic forces operative in chemical reactions. We have not yet reached the stage when theoretical chemistry may be described as a branch of mathematical physics, but we are certainly tending in that direction. It is, therefore, only appropriate that the coming generation of physical chemists should realise the situation and make themselves familiar with the newer physical ideas and mathematical methods before they become "too old to learn". Only thus can they hope to really understand their subject or to make any contributions to it.

The treatise under review will undoubtedly assist in giving the new orientation desired for the teaching of physical chemistry to the rising generation. It may be a shock to the orthodox physical chemist to find a treatise on his subject which leaves out the theory of solutions, ignores colloid chemistry and even makes no mention of the phase-rule. But such omissions could scarcely be avoided if room were to be found for developing the foundations on which could be based a rational treatment of chemical thermo-dynamics, chemical equilibria and chemical kinetics.

As remarked by the author in his Preface, "the book is complete in itself; it does not expect of the student that he shall have at his elbow a number of other books. All theorems are derived; no proof is taken for granted". These are valuable features which will be greatly appreciated by teacher and student alike.

The book is very heartily commended.

C. V. RAMAN.

* *Physical Chemistry—An Introduction.* By Dr. E. A. Moelwin-Hughes. (Cambridge University Press), 1940. Pp. viii + 660. Price 45*sh.*

Advances in Enzymology, Vol. I. Edited by F. F. Nord and C. H. Werkman. (Interscience Publishers, Inc., New York), 1941. Pp. x + 433. Price $5.50.

Early in 1939, it was learnt that Professor Nord chose to leave his country and that the University of Fordham had extended its hospitality to the illustrious founder and editor of *Ergebnisse der Enzymforschung*. His friends the world over were expecting that he would organise the publication of another series.

The present volume marks the commencement of the expected series and is intended to be of "service to those investigators who are devoting their efforts to extending our knowledge" in the field of enzymes and related subjects. The scope of this series is sufficiently broadbased to include critical reviews on proteins, viruses, photosynthesis and differs in this respect from the series, the *Ergebnisse der Enzymforschung* whose eighth, and we believe, the last volume, was published early in 1939; the series has apparently suspended its publication, presumably on account of the distractions and privations incidental to modern wars which render the peaceful pursuit of fundamental research difficult if not impossible.

The volume consists of ten contributions; the appropriateness of prefacing the series with a provocative review on protein structure is realised if attention is called to the impressive assemblage of "active proteins" which have been isolated during the last decade in a state of integral purity and crystallinity. Although the nature of the prosthetic group of several of the dehydrogenases, has been largely elucidated, practically nothing is known about the corresponding apodehydrogenase and the virus proteins. The next phase of development in the field of oxidation and reduction enzymes and viruses will lie in the elucidation of the nature of the active groups characterising these "active" proteins. Bull's discussion on protein structure which draws pointed attention to the several shortcomings in the present theory of protein structure, is most opportune; it will serve to focus attention on the several obscure points and stimulate further work in this important field.

The second contribution by Holzapfel relates to a consideration of the physicochemical behaviour of plant viruses in relation to their activity. Bergman and Fruton have discussed the specificity of protinases, a subject to which they have made fundamental contributions. The phosphorylations which precede the stepwise fission of carbohydrates, the intermolecular transfer of hydrogen and the transportation of entire groups or radicles from one molecule to another, are all coupled with the energy changes associated with the phosphate bond. In an informative article on the metabolic generation and utilisation of phosphate bond energy, Lipmann has surveyed the subject of the energetics of cell metabolism in relation to the role played by

phosphorus. The chemical nature of catalase has been reviewed by Summer and the functional character of the low molecular weight prosthetic groups—coenzymes which include vitamins, heavy metals, etc., is discussed by Green whose share in the development of this field has been large and spectacular. Other contributions include reviews on photosynthesis, Bacterial photosynthesis, Enzymatic processes in living plants and the Digestion in lower vertebrates. It will thus be seen that the volume covers a wide and comprehensive field of Enzymology and related subjects. Scientific workers will feel particularly grateful to Professor Nord and his collaborators for inaugurating this series and we wish to take this opportunity of wishing their venture an uninterrupted career of service in promoting the advancement of Enzymology.

Modern Pottery Manufacture. By H. N. Bose. (Ceramic Publishing House, 1, Church Road, Bhagalpur), 1942. Pp. vi + 481. Price Rs. 6-8-0.

This book has been written mainly as a text-book for undergraduate students of ceramics in India, but it will also be found useful to many practical workers in the field, particularly for the assortment of practical formulas using Indian raw materials which have been tried out by the author in the laboratories and ceramic plants of the Benares Hindu University. Considered purely from the didactic point of view, there is scope for improvement in the presentation: expressions such as "graphite is a peculiar form of carbon" on page 320, and elementary portions such as the "mathematical calculations" on page 437, can be eliminated, and some of the diagrams such as Figs. 6, 23, 25 and 51 can be corrected and improved. An index will add considerably to the value of the book as a reference volume, particularly as it embraces all the different branches of the subject such as porcelain, stoneware, refractories, fuels, furnace and kilns, in one handy volume. We do hope that in the future editions to come, this essentially practical volume will grow to a higher standard of usefulness to all ceramists in India.

The book is rightly dedicated to "Reverend Pandit Madan Mohan Malaviya, the great Indian Educationist, who had the keen insight to recognise the importance of Ceramics to India, and first started the scientific training in the subject in the Benares Hindu University.

S. J.

Pheretima (An Indian Earthworm). By Karm Narayan Bahl. (*The Indian Zoological Memoirs*, Lucknow), January 1943. Price Rs. 1-12-0.

The series of Zoological monographs entitled "Indian Zoological Memoirs" is so well known to all zoologists in this country that it should not need any further introduction for the readers of *Current Science*. It may, however, be noted that the series was started in 1926 under the editorship of Dr. Karm Narayan Bahl, Professor of Zoology, Lucknow University, and eight memoirs have already been published The memoir under review is the third edition of the first memoir of the series, the editor's *opus magnum*, on *Pheretima* (an Indian earthworm). The first edition was published in 1926, the second in 1936, while a new and entirely revised edition has been issued in January 1943. The usefulness of the work can be gauged from the fact that within less than two decades two new editions have been issued.

The work, as it stands, is probably the most complete account available of any of the commoner Invertebrates of India. The author has spared no pains in bringing the text up-to-date by incorporating the results of all recent work, by thoroughly revising the descriptive account, and by the incorporation of additional illustrations. He has also indicated where our knowledge about this worm is deficient and where further research is desirable. The memoir is excellently printed and is remarkably free from misprints. The author deserves the best thanks of the zoologists in India for this excellent memoir, and it is hoped that further volumes in the series will be published as and when ready so as to provide students of Indian Zoology with authoritative accounts of various Indian types.

B. P.

INDIAN STATISTICAL CONFERENCE

A LAST minute change in the venue of the Conference, the inability of the Governor of the Province to open the Session in person and with customary ceremony, a demonstration at the gates timed to synchronise with the arrival of the Vice-Chancellor of the University and the Chairman of the Reception Committee, and above all, the threat of air raids and the sight of enemy aircraft actually brought down in wreck and fire in the area, are not occurrences expected by any known statistical law or hypothesis and yet the goodness of fit between the Sixth Session of the Indian Statistical Conference at Calcutta in January last and the previous five annual meetings is both high and helpful. There was a Message from His Excellency the Governor which reminded that when peace comes, when commerce, future of industry and of the economic life of the peoples have to be planned, it is statistical science that would largely help in fashioning them. The Hon'ble Mr. N. R. Sarkar stressed the same thought in his presidential address. "It is well nigh impossible", said the President who is also the Commerce Member in the Viceroy's Executive Council, "to prosecute a totalitarian war without the aid of the statistician at every turn. Problems of price control, rationing, production and distribution of food and clothing, maintenance of real wages and regulation of dearness allowance, all these required careful collection of data and the scientific study of relevant statistics."

The stage thus set was a valuable lead to the scientific meetings of the Conference. In

the discussion on Applied Statistics, Professor Benoy Kumar Sircar explained the use of statistics in economic planning with special reference to Russia. Census figures of Bengal, enquiry on behalf of "Capital" into the budgets of Anglo-Indian and European families in Calcutta, the Labour Office inquiries in Nagpur, the defects of Laspeyer Index and the method of sample surveys were brought into the scope of the discussions. In the course of the development of each bit of scientific knowledge there comes a time when the experimental technique must be questioned. Are they adequate to furnish the demanded precision of results? Is the most helpful point of attack in the laboratory methods or in the experimental material? Fortunately statistical methods supply answers in many cases with little or no extra labour in collecting data, provided only that slight but necessary modification be included in the plan of the experiment. This possibility has been brought to the foreground in a very clear manner in the analysis of agricultural statistics, and quite naturally that subject claimed a session for itself in the discussions. The Chairman, Mr. R. C. Bose, drew attention to the use of Finite Geometries in furnishing completely general solutions for all problems concerning Symmetrical Factorial Designs. The scope of the teaching of Statistics in Indian Universities, with equal emphasis on analytical and descriptive statistics, elicited good discussion in which Prof. F. W. Levi, Prof. P. C. Mahalanobis, and Mr. Tu Yun Sun of the National Tsing Hua University, took part. Earlier in the day, Dr. B. C. Roy, as Chairman of the Reception Committee, had narrated the measures taken in that direction by the Calcutta University.

No account of the Statistical Conference can be complete without reference to the work of the Calcutta Statistical Laboratory and to the journal *Sankhya*, both of which, as His Excellency rightly acclaimed, are "monuments to the foresight and indefatigable labours of Professor Mahalanobis to whose devoted enthusiasm for statistics India is deeply indebted". The Statistical Laboratory has undertaken with great success a large number of inquiries on behalf of the Government of India as well as Provincial Governments and of States such as the production of important food crops like paddy and wheat, cash crops like jute and sugarcane. It has investigated problems of flood control and irrigation, anti-malaria measures, nutritional programmes, cinchona production, average lifetime of rupee notes in circulation and so on. The list of papers published and reports submitted during 1942 includes no fewer than thirty titles from ten different authors. The financial condition of such an Institute must undoubtedly be above anxiety, but in the words of the Honorary Secretary, "this year, for example, no less than two lakhs of rupees will have been spent, but in three months' time our income may literally drop to zero because we have no permanent grants or endowments. Though this very insecurity has developed our self-confidence, there is a point beyond which such insecurity begins to exert a harmful influence". It is to be hoped that the contingency last indicated may never arise.

K. B. M.

CENTENARIES

Banks, Joseph (1743–1820)

JOSEPH BANKS, British botanist and pioneer explorer, was born in London, 13 February 1743. He was immoderately playful till his fourteenth year when he suddenly became a botanist in a burst of schoolboy enthusiasm. One fine summer evening he had stayed bathing in the Thames so long, that he found that all his companions had gone. Walking back leisurely along a lane, he was struck by the beauty of the flowers on either side. He immediately decided to learn botany. He learned from a woman employed in collecting herbs for a druggist's shop paying her six pence per lesson. When he went home for the next holidays, he picked up Gerard's *Herball* in his mother's dressing room. This not only described his plants but also contained engravings of them. When he went to Oxford in 1760, botany was not taught there. But his enthusiasm for the subject made him go to Cambridge and bring a private tutor.

His father's death brought him an ample fortune and an estate. He, therefore, left Oxford in 1763. But his superior attainments in natural history secured for him Fellowship of the Royal Society as early as 1766.

The epic days of scientific exploration began with Banks, who obtained permission to accompany Captain Cook in his *Endeavour* taking his own technical staff with him. The *Journal* which he kept was utilised in the relation of that famous voyage round the world (1768-1771). It was admirably kept and he never let a day pass without an observation. After changing several hands the *Journal* was finally deposited in the British Museum and was not printed till Hooker edited and published it in 1896.

Banks was elected President of the Royal Society in 1778 and his drive caused quite a stir in the Society and in spite of much revolt from some he kept that position till his death. Though his writings were very few and some of them still remain as manuscripts in the British Museum, he employed himself with extraordinary zeal and industry to collecting and observing. His contribution to the growth of science was even greater as a munificent and influential patron. His vast collections and his library, the biggest of its kind in the country, were freely accessible to all scientific men and his house in Soho Square was the focus of science. His library is still preserved by itself in a room of the British Museum and his collections, at South Kensington.

He was scientific adviser to George III,

whom he persuaded to purchase a house in 1818 to provide a Herbarium and a Library for the Kew Gardens. The use of the house was, however, delayed by the death of both. George IV sold it to the nation in 1824 for £84,000 to clear his debts. William IV gave it away to the Duchess of Cumberland. It was not till 1837 that Victoria lent it to the Gardens and it was not discovered till 1876 that it had been already purchased from George IV.

Banks was fair to the core in his attitude towards foreign naturalists. Sometimes it was even proved embarrassing. For example, when the collections made by La Billardiere fell by fortune of war into the British hands, Banks managed to have them handed back to France, saying that he would not steal a single botanic idea from those who had gone in peril of their lives to get them. Ten times were parcels addressed to the Royal Garden at Paris, captured by English cruisers and each time they were returned.

Banks died at Spring Grove, 19 June 1820.

Seed, Miles Ainscough (1843—1913)

MILES AINSCOUGH SEED, the inventor of the dry plate, was born in Preston, 24 February 1843. He became vitally interested in photography, then in its infancy and began experimenting with different processes for making and developing photographic plates. Finding the conditions in his native land unfavourable, he migrated to the United States in 1865. After several years of persistent effort, he succeeded in hitting upon the idea of the dry plate and established in 1882 the M. A. Seed Dry Plate Co., in St. Louis. By reason of his tenacity and personal visits and propaganda he overcame the prejudice of photographers against his new invention. Eventually it turned out that his dry plate was the first one sensitive enough to be used for X-ray purposes and for astronomical photography.

Seed died at Pelham, 4 December 1913.

Madras University Library,
February 4, 1943. S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Germination of Ergot.—In his letter dated December 16, 1942, Mr. A. B. Bose, Botany Laboratory, Carmichael Medical College, Calcutta, writes:—"It has been brought to my notice by Prof. H. P. Chaudhuri of the Punjab University, that after the publication of Dr. Pushkar Nath's note in *Current Science* (1941, p. 488), Prof. Chaudhuri got a new collection from Simla and it was from this collection that he kindly sent me some material. The material was not, therefore, obtained from Dr. Pushkar Nath as stated by me previously (*Curr. Sci.*, 1942, p. 439) due to misapprehension."

Manufacture of Newsprint, Cheap Papers and Boards in India.—The possibility of utilising indigenous raw materials for the manufacture of cheap newsprint has received attention from a long time past. But, till recently the Indian demand for newsprint was so limited that it was hardly economic to put up a plant even if other conditions permitted such a step. But this market has steadily expanded and quite apart from this, war conditions have compelled a thorough review of the feasibility of Indian manufacture of these imported commodities. Such a review is contained in an interim report by Messrs. M. P. Bhargava and S. Kartar Singh (*Indian Forest Bulletin*, No. 108, 1942. Price As. 9 or 10d.) whose conclusions are not very encouraging. After experimenting with various Indian species, three of conifers, seven of broad-leaved species and three bamboos, these authors find fir and spruce (available in fair quantities in certain parts of India), quite suitable for newsprint production while three of the broad-leaved species were considered promising. Unfortunately, however, the two conifers abound in areas where cheap power is not available so that the prospects for a thriving Indian newsprint industry are none too favourable just at present. The bulletin contains sixteen samples of paper with their composition of mechanical pulp and chemical pulp indicated. The sober conclusions recorded in this bulletin should be helpful in dispelling facile optimism about ambitious but ill-conceived schemes for newsprint production in the country.

Factors Governing the Adhesion of Tin-Base Bearing Metals.—The Tin Research Institute's publication No. III records a comprehensive study of the factors governing the adhesion of tin-base bearing alloys to various backing metals, including steel, bronze, copper, brass and cast iron, by W. T. Pell-Walpole, J. C. Prytherch, and B. Chalmers. The conditions for obtaining efficient bonds are considered, and the many factors affecting these conditions in manufacturing operations are examined. A large number of tests are described which indicate the most suitable methods of preparing and tinning the bearing shell, and of casting and cooling the lining. The results of thousands of individual tests show the effects of variations in alloy composition, mould design, temperature of metal and mould, and rate and direction of cooling, in relation to both hand-pouring and die-casting and also to centrifugal methods of production. The part played by shrinkage cavities at or near the bond is also examined, and methods of operation are suggested by which this trouble may be avoided. Copies of this paper may be obtained free of charge from the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Plywood Tyres. — According to *Indian Forester*, a note in *Timber Trade Journal* of July 1942 mentions a plywood tyre taking the

place of solid rubber tyres and of trials having been very successful. Three rings of 1¾" plywood were fastened together and put on the rear wheel. The wear was slight and even, and traction on wet boards better than with rubber tyres and on dry boards about equal with the rubber variety. It is reported that drivers cannot tell the difference in driving the vehicle with the odd tyre on one wheel.

Chemotherapy and Tuberculosis.—It is possible that the long-wished-for remedy for tuberculosis may eventually come through chemotherapy. Recently, 'Promin', the didextrose sulphonate of diaminodiphenyl sulphone, a member of the suplhonamide group, has been found by Feldman and Hinshaw at Rochester, U.S.A., to be active against the tubercle bacillus both *in vitro* and *in vivo*. Prof. W. H. Tytler, of the Welsh National School of Medicine, Cardiff, has made some experimental studies with 'Promin' (*Thirtieth Annual Report* for the year ended 31st March 1942, of the King Edward VII Welsh National Memorial Association. *Report of the Director of Research*, p. 46). His results so far show that it is the most effective chemotherapeutic agent for the tuberculous guinea-pig yet tested. Unfortunately, the toxicity of the drug in the high continued dosage necessary has hitherto prevented its full therapeutic application to human beings, although in local application to superficial tuberculous lesions it is efficacious. This objection may eventually be overcome, possibly by combining the administration of the drug with that of an antigenic serum or by other modifications of its toxic properties. At all events the discovery of this drug represents an important advance and may be the prelude to greater things.—*Nature* (1942, 150, 517).

Laxminarayan Institute of Technology, Nagpur.—In the presence of a distinguished gathering, His Excellency Sir Henry Twynam, Governor of the Central Provinces and Berar, opened the Laxminarayan Institute of Technology, Nagpur, on January 9. The Governor also unveiled a bronze statue of the late Rao Bahadur D. Laxminarayan, who bequeathed his whole estate worth about Rs. 35,00,000 for the study of applied science and chemistry in the Nagpur University. Mrs. D. Laxminarayan was present.

Requesting His Excellency to perform the opening ceremony of the Institute, Lt.-Col. T. J. Kedar, Vice-Chancellor, said that they all realised that for a Province like theirs, rich in its raw materials like oil seeds, manganese and untapped forest produce, the starting of a Technical Institute was a step in the right direction. "We have also taken care to see that training given to the students is not merely of an academic nature without any idea of actual industrial requirements, by having amongst the staff men who have had several years' experience of erection and working of factories in India, all of which augurs well for the future".

Declaring the Institute open, Sir Henry Twynam observed that at long last, the dream of the princely donor of teaching applied chemistry to the students of the Province had been realised and complimented Lt.-Col. T. J. Kedar, Vice-Chancellor, for the manner in which he successfully overcame the various obstacles in the way of establishing the Institute. He also paid a warm tribute to the munificence of the late Rao Bahadur. His Excellency regretted that the Hon'ble Mr. N. R. Sarker, Commerce Member of the Government of India, could not be amongst them to deliver the inaugural address on the occasion. The inaugural address of the Hon'ble Mr. Sarker was read in his absence by Major N. Ganguli. A. N. K.

Indian Central Jute Committee.—Mr. I. G. Kennedy was elected Vice-President of the Indian Central Jute Committee for 1943-44 at its meeting held to-day under the presidency of Mr. P. M. Kharegat, C.I.E., I.C.S., President of the Committee and Vice-Chairman of the Imperial Council of Agricultural Research.

The proceedings opened with a short speech by the President condoling, on behalf of the Committee, the death of Sir Bryce Burt, the first President of the Committee, recently in England, and offering felicitations to Lala Padampet Singhania on the recent conferment of Knighthood and to Mr. H. M. Jhunjhunwalla on the conferment of the title of Rai Saheb, both members of the Committee.

Vacancies having arisen in the Standing Technical Sub-Committees due to the expiry of the terms of certain members, in addition to the sitting members, the following were appointed to the Sub-Committees noted against their names:—

Local Sub-Committee: Mr. S. N. Biswas, Mr. M. A. H. Ispahani and Mr. M. P. Birla; *Agricultural Research Sub-Committee*: Mr. A. M. A. Zaman, Mr. A. L. Mondal and Mr. S. N. Biswas; *Technological Research Sub-Committee*: Mr. M. A. H. Ispahani, Mr. M. P. Birla and Mr. C. L. Bajoria; *Marketing Sub-Committee*: Mr. A. L. Mondal, Mr. S. N. Biswas and Mr. A. M. A. Zaman; *Economic Research and Publicity Sub-Committee*: Mr. M. A. H. Ispahani, Mr. M. P. Birla and Mr. S. N. Biswas.

Textile Essay Competitions: Award of Prizes and Medals.—These competitions are open to all from all parts of India, and no entry fee will be charged. The competitors need not be members of the Textile Association. [Members of the Managing Committee of the Textile Association (*India*) are not eligible.]

There will be five separate competitions as follows: (1) Improvements in Textile Machinery—Original. (2) Improvements in Textile Manufacturing Technique—Original. (3) Latest Developments in Textile Machinery or Processes—Survey or Original. (4) Labour and Welfare, pertaining to Textile Industries. (5) Indian Textile Fibres, their Production and Utilization.

A competitor may, if he so desires, submit papers on more subjects than one. Each paper shall be treated alternatively; but a competitor will not be eligible to receive more than one prize.

All papers shall be in English. The length of the paper shall not exceed fifteen foolscap size sheets (30-32 lines to a sheet) with a margin of about two inches, typed on one side only. Inclusion of illustrations, graphs or tables, hand-drawn, is permitted.

The paper must be enclosed in a sealed cover, on which the competitor should write particulars as under:—

Prize Competition Paper, *Nom-de-plume*, Subject or Subjects.

Subjects requiring originality must be original and vouchsafed as such. Reference from other papers is allowed if duly acknowledged with such details as (1) Name of source, (2) Date of publication, (3) Name of author, (4) Page and (5) Year.

The competitor's name should not appear anywhere, in the paper or on the envelope in which the paper is enclosed. In another sealed cover of a smaller size with details as above, the competitor should enclose a separate paper giving the following particulars:—

Full Name, Postal Address, Name of Employer if employed, and capacity in which employed, Age, Technical Qualification if any, and duration of practical experience in Textile line.

On the outside of the small cover, the competitor should write his *Nom-de-jlume* only.

Both the sealed covers should be enclosed in a large cover and delivered to the Hon. Secretary of the Association, in person, per bearer or through post, under a registered cover, so as to reach him on or before the end of 30th April 1943. Unstamped or insufficiently stamped envelopes are liable to be returned.

The judges of the competitions will be appointed as follows:—

Two independent persons of position from the public and one nominated by the donor, for each of the five competitions.

Majority opinion of the judges will be final as regards the prize in each subject. The final declaration of the prizes will be made by the Managing Committee of the Textile Association (*India*).

Prizes will be awarded as follows: (1) Improvements in Textile Machinery—*The Textile Association* (India) *Gold Medal* of the value of Rs. 150. (2) Improvements in Textile Manufacturing Technique—*The Delhi Cloth Mills' Prize* of the value of Rs. 200. (3) Latest Developments in Textile Machinery or Processes—*The Khatau Gold Medal* of the value of Rs. 100 and Rs. 201 cash prize to the same person. (4) Labour and Welfare pertaining to Textile Industries—*'The Indian Textile Journal' Prize* of the value of Rs. 150. (5) Indian Textile Fibres, Their Production and Utilization—*E. D. Sassoon Mills' Prize* of the value of Rs. 300.

The result of these competitions will be declared by the 15th June 1943, or earlier if possible.

If, in the opinion of the Examiners, a competitor's essay falls below the standard expected, in such a competition, they may not award any Prize and/or Medal to him, even though it may be the best amongst the essays submitted on that subject. The Examiners may, at their absolute discretion, recommend to the Managing Committee, the award of a prize of smaller value in such a case.

The award of Prizes or Medals will be confirmed by Certificate of Merit issued by the Textile Association (*India*).

The closing date of the Competition is 30th April 1943.

Further particulars may be had from:—Narain V. Ullal, Hon. Secretary, The Textile Association (*India*), "Ganesh Bhavan," Parel P.O., Bombay.

Archives of Biochemistry, a new journal on biochemistry, has been announced by the publishers, The Academic Press, Inc., 125 East, 23rd Street, New York City. The first issue will appear about the middle of October. The purpose of the new journal is to provide a medium of publication for scientific papers in the widening scope of biochemistry. The fields to be represented are: Proteins, hormones, vitamins, viruses, enzymology, biochemical and biophysical research in chromosomes, metabolism, nutrition, photosynthesis, plant chemistry, organic chemistry as far as related to living organisms, colloid science in its biological applications and chemotherapy. The Editorial Board is composed of Professors M. L. Crossley, American Cyanamid Company, Bound Brook, N.J.; R. A. Gortner, University of Minnesota; F. C. Koch, Research Department of Armour and Company, Chicago; C. M. McCay, Cornell University; F. W. Nord, Fordham University; F. W. Went, California Institute of Technology, and C. H. Werkman, Iowa State College. Manuscripts may be sent to any of the editors or to the editorial office at 125 East, 23rd Street, New York City. Two volumes per year are planned, the cost of each volume being $5.50.

—*Science*, 1942, 96, 269.

Bruhl Medal.—Rao Bahadur G. N. Rangaswami Ayyangar, B.A., F.N.I., I.A.S. (Retired), of Coimbatore, has been awarded the BRUHL MEDAL by the Royal Asiatic Society of Bengal, for his meritorious research work in Botany. Our hearty felicitations to the distinguished recipient.

Lucknow University.—The following candidates have been declared eligible to receive the degree of PH.D. in the Faculty of Science, Lucknow University:—

(1) Mr. Rajendra Varma Sitholey, M.SC., on a thesis comprising a series of papers on "Fossil Plants from India, Ceylon and Afghan-Turkistan". (2) Miss Mary Chandy, M.A., on "The Anatomy of the Sting-Ray (*Trygon*)". (3) Mr. Bijan Bihari Lal, M.SC., on "The Photochemical Reactions in Solution: The Photochemical After-Effect".

Mr. Vidya Bhaskar Shukla, M.SC., has been declared eligible to receive the Ruchi Ram Sahni Research Prize in Botany on the basis of a dissertation comprising original papers on fossil plants from the Deccan Inter-trappean Series.

SEISMOLOGICAL NOTES

During the month of December 1942, ten slight and two moderate earthquake shocks were recorded by the Colaba seismographs as against one great, three moderate and three slight ones during the same month in 1941. Details for December 1942 are given in the following table:—

Date	Intensity of shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	(Miles)		(Miles)	-
3	Slight	01	05	2490	..	..	..
4	Slight	21	55	5520	..	..	..
5	Slight	20	58	6420	..	..	..
10	Slight	04	49	6150	..	..	..
11	Moderate	09	09	2760	..	..	Epicentral region located in Anatolia. Several houses collapsed and many were damaged in Northern Anatolia. The shocks were especially severe in Tchorum District.
19	Slight	15	51	1270	..	..	
20	Moderate	20	33	2490	..	..	Epicentral region located in Central Anatolia. Over 1,000 persons killed and more than 3,000 wounded in the region of Tokat in Central Anatolia. One township was completely destroyed.
22	Slight	03	51	1670	..	140	..
23	Slight	11	40	1590	..	..	..
23	Slight	20	29	5530	..	..	..
27	Slight	23	10	4410	..	..	..
29	Slight	10	12	3630	..	..	..

MAGNETIC NOTES

Magnetic conditions during December 1942 were slightly more disturbed than in the previous month. There were 16 *quiet* days, 13 *slightly disturbed* days and 2 days of *moderate* disturbance during December 1942 as against 13 quiet days, 16 days of slight disturbance, 1 of moderate disturbance and 1 of great disturbance during the same month in 1941.

The quietest day during December 1942 was the 30th, while the 23rd was the day of largest disturbance.

The individual days were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
1, 2, 5, 6, 13, 15–19, 25, 27–31.	3, 4, 7–12, 14, 20, 22, 24, 26.	21, 23.

No magnetic storms occurred during December 1942, while one storm of great intensity was recorded during December 1941.

The mean character figure for the month of December 1942 was 0·55 as against 0·65 for December 1941.

M. V. Sivaramakrishnan.

Dr. K. N. Menon, Professor of Chemistry, Maharaja's College, Ernakulam, writes:—"Kindly allow me to associate with the feelings you have expressed in the obituary notice (*Curr. Sci.*, 1943, p. 12) announcing the death of Richard Willstatter. It may be a very long time before we will have the opportunity to read a memorial lecture but may I be permitted to suggest to all who are interested in getting a short but lucid exposition of the contributions to the various branches of organic chemistry and biochemistry made by Willstatter and his collaborators, to read the issue of *Naturwissenschaften*, published on 12th August 1932 to commemorate Willstatter's sixtieth birthday?"

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 90, Nos. 4623 and 4625.

"Indian Journal of Agricultural Science," Vol. 12, No. 5.

"Journal of Agricultural Research," Vol. 65, Nos. 5 and 6.

"Agricultural Gazette of New South Wales," Vol. 53, Pts. 11 and 12.

"Journal of Chemical Physics," Vol. 10. No. 10.

"Indian Forester," Vol. 69, No. 2.

"Bulletin of the Indian Central Jute Committee," Vol. 50, No. 10.

"Journal of the Indian Mathematical Society," Vol. 6, No. 3.

"The Mathematics Student," Vol. 10, No. 2.

"Indian Medical Gazette," Vol. 78, No. 1.

"Review of Applied Mycology," Vol. 21, Pt. 10.

"Nature," Vol. 150, Nos. 3804, 3805, 3809 and 3810.

"Science," Vol. 96, Nos. 2491-2494.

"Sankhya," Vol. 6, Pt. 2.

"Science and Culture," Vol. 8, No. 8.

"Sky," Vol. 1, No. 12.

"Indian Trade Journal," Vol. 148, 1907-1911.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XII] INDIAN SCIENCE CONGRESS, CALCUTTA, 1943 [No. 2

Summaries of Addresses of the General President and Presidents of Sections

PRESIDENTIAL ADDRESS

General President: D. N. WADIA, ESQ., M.A., B.SC., F.G.S., F.R.G.S., F.R.A.S.B.

MINERALS' SHARE IN THE WAR

IN his General Presidential Address to the Thirtieth Session of the Indian Science Congress which met in Calcutta last January, Mr. D. N. Wadia deals with the question of "Minerals' Share in the War", in the course of which he observes:

"It is no exaggeration to say that half of the later wars of history have been directly or indirectly motivated through the desire of gaining access to stores of strategic mineral products, ores, fuels, salts, alloy metals and essential industrial minerals.

"The international mineral situation during pre-war years was in a chaotic state. While the United Nations were in a state of 'vacuous unwareness' about it, the Axis powers grabbed as much of the indispensable munitions minerals as they wanted and the war has been waged by them on the stores of hoarded minerals and metals.

"Only the adoption of a wise and justly planned international mineral policy framed by an International Directorate can preserve peace and goodwill amongst countries unequally endowed by Nature with mineral wealth. No country in the world, however well-supplied it be, is self-sufficient in mineral requirements, nor is any so situated that it can regard its mineral resources as purely domestic or national. Embargoes, tariffs, patent rights and transport controls imposed for political reasons do not offer a solution, but by hindering free movement of minerals become powerful contributive factors in precipitating world wars. Unequal geographical distribution of minerals being an unalterable fact, planned international economy should devise means not only to eliminate this cause of inter-country friction but to increase the interdependence of nations on each other for their vital trades and industrial needs and so make minerals a rallying point for international co-operation and goodwill."

Talking about the Social Obligations and Relations of Science in India, Mr. Wadia writes:

"The impact of science on the Indian masses has come in the form of a rather rude intrusion of machines and mechanics into the essentially simple rural economy of the country and it is not surprising that this meeting has not been a particularly happy one. It has disturbed the economic structure and created, if not some aversion, an indifference to the cult of science in the popular mind. But we all know that science is not all mechanics nor are its practical uses to man the greatest thing about science. The greatest thing about science is the scientific method—the most effective thing man has for discovering truth and the ways of Nature. It can bring solid benefits by releasing life from stagnation and the bonds of ignorance wherever these prevail, whether in cities or in the countryside, among the labouring masses or among the governing class. The awakening to the social obligations of science is of recent date and even in Europe and America, this aspect of the cultivation of science was for long not realised and left to sporadic individual efforts. With this awakening, a twofold problem faces science all over the world to-day—to press the newest discoveries and inventions of applied science into the service of agriculture, manufactories, hospitals, homes and schools and alongside with it to so control the impact of these on his private life that his mechanised work-a-day life may not be totally divested of all higher spiritual values. Our future national life and its material well-being largely depend on a wholesome balance being maintained between these two—the impulse to harness science to increase physical comforts of life and a restraining desire to preserve the old world spiritual calm and simplicity of living."

In the concluding part of his Address, Mr. Wadia outlines a scheme for a proposed Academy of Social Science for India to promote "peace among nations and intellectual freedom in order that Science may continue to advance and spread more abundantly its benefits to all mankind". According to Mr. Wadia:

"The proposed Academy should be a body of high academic standing and professional knowledge, which can take up long-range problems of social well-being of the people of India which the older Societies and Associations established along familiar but too general lines in some cases and rather over-specialised lines in others, cannot deal with without suspicion of religious or political bias. Socio-medical and political subjects, human relations, anthropology, political science, vital statistics, social biology, population problems, sociological research in particular bearing on various Indian communities are the subjects on which such an Academy can work in collaboration with the Indian Science Congress and half a dozen other institutions already existing in the country for some of the above-named specific objects. It can be a living organ in the body politic of India for voicing the collective opinion and focussing the specialised points of view of numerous isolated working bodies on the one problem how to promote the well-being of the common man."

PHYSICS

President: DR. H. J. BHABHA, F.R.S.

RECENT ADVANCES IN THE THEORY OF FUNDAMENTAL PARTICLES

SCIENTIFIC activity began with the recording of facts of observation. This was followed by generalisations or laws based empirically on the record of such facts. Newton, by enunciating his laws of dynamics and gravitation, introduced a *new approach* to physical theory. He showed clearly that the ideas which are to be regarded as *fundamental* for the understanding of nature are certain *abstract concepts and postulates* on the basis of which certain results could be derived mathematically and compared with the facts of observation. This position was accepted because it was the only way to obtain a unified scheme for the observed regularities of nature. On the basis of such postulates, a physical theory is built up. If a newly discovered fact does not fit in with the theory, it necessitates a revision of the postulates leading to a more general theory from which the results of the older theory would follow as approximations. An example of this type of change is the theory of relativity.

The principle of relativity imposes restrictions on any physical theory that can be built up. So does the quantum theory. On the basis of the latter, Heisenberg showed that it is impossible to determine the position and momentum of a particle *simultaneously* with *unlimited accuracy*. Consequently the attempt to calculate the *exact* trajectory of a particle in space-time is abandoned. Instead, we now calculate the *probability* of a particle being in a given region of space at a given time. Consequently, the problem of mechanics at present is one of calculating a set of functions called *wave functions* from which physical properties associated with a particle can be derived. The possible wave equations from which such functions can be calculated and which satisfy the limitations imposed by the principle of relativity and the quantum theory have been given by Dirac, Pauli and Fierz. They can be shewn to describe elementary particles with integral and half integral spins. One important result of combining the relativity and quantum theories is the realisation that a one-body problem is impossible in relativistic quantum mechanics. The theory gives solutions which correspond to the particle being in states of negative kinetic energy. These solutions cannot be ruled out because transitions are possible between such negative states and positive states. Dirac overcame this difficulty by saying that all such states are normally occupied. Consequently there will be infinite and uniform distribution of charge which will produce no field. It is possible, sometimes, for a particle in a negative energy state to jump into a positive energy state. The empty negative energy state or "hole" becomes observable as a particle of the same mass but opposite charge. This corresponds to a positron in the case of the electron. The theory thus predicts the existence of the positron and the possible creation of positron-electron pairs. It is, therefore, clear that a one-body problem is impossible in relativistic quantum mechanics. These results have been verified experimentally by Anderson and by Blackett. Further developments have shewn that a physical theory of particles of half integral spin is impossible unless they satisfy the Fermi-Dirac statistics. Similarly a theory of particles with integral spin is impossible unless they satisfy the Bose-Einstein statistics.

One serious limitation of the quantum theory in its present form is that it leads to divergent results in higher approximations. This was first noticed in the interaction of electrons with radiation and it was believed that it was connected with the fact that the charge of the electron was assumed to be concentrated in a point. The work of Dirac, Pryce and Bhabha has shewn that this view is false. Dirac and Pryce have worked out a complete *classical* relativistic theory of a point electron moving in an electromagnetic field by taking into account the effects of radiation reaction on the motion of the electron exactly. Bhabha has extended the theory to spinning particles having a dipole interaction with the electromagnetic field. He has also shewn that an equally successful relativistic classical theory can be made for charged and spinning particles moving in meson fields. In all these theories, the mass of the particle is looked upon as an arbitrary mechanical constant which has nothing to do with the field the particle creates. Although the quantum theory in its present form treats the fundamental particles as points, no way of removing the infinites in an unambiguous and relativistically invariant way has been found.

GEOLOGY AND GEOGRAPHY

President: DR. J. A. DUNN

SUGGESTIONS FOR THE FUTURE DEVELOPMENT OF INDIA'S MINERAL RESOURCES

IN his Presidential Address to the Section of Geology and Geography, Dr. J. A. Dunn of the Geological Survey of India offers certain valuable suggestions for the future development of Indian mineral resources, based on his knowledge and experience during more than twenty years of scientific work done in this country continuously in connection with the mineral industry; and has specially dealt with the future actual development of the mineral resources in India. After pointing out that the two statements commonly made with regard to India's mineral position, *viz.*, (1) that India is poor in mineral resources and (2) that such mineral resources as are available here have not been developed as fully as they should have been, are both mistaken, Dr. Dunn proceeds to point out that India's mineral industry has been far from negligible and has been a valuable asset to the country. Reviewing the actual geographical distribution of minerals in the country, he shows how the different parts of India are inter-dependent and that, therefore, a co-ordinated mineral policy applied to the whole

country as a unit is desirable. Talking of the expansion of the mineral industry, he points out that this may include both the development of new mineral deposits and the creation of new industries from minerals already mined, and proceeds to discuss in detail the possible direction of expansion with reference to about forty of the more commonly occurring minerals of economic value found in India. Dealing with the several lines along which enquiries may be pursued with a view to the ultimate expansion of the mineral industry, Dr. Dunn observes: "The stimulation of prospecting must be co-ordinated with methods of prospecting, the mineral deposits must be closely studied geologically to obtain the maximum from the resources available, methods of mining must be improved, and also methods of treatment, whilst the extended use of minerals in industry must receive constant attention." In conclusion he refers to the various ways in which the State can assist the mineral industry, and points out the great and urgent need for establishing a "Minerals and Metals Research Bureau" in this country, including a "Fuel Research Station", to undertake investigations into all aspects of the mineral industry—particularly with a view to improve methods of mining, reduce cost of treatment, and further extend the application of certain minerals into fields other than those in which they are already used. From a wider point of view, it is clear that in framing a mineral policy, each country must be not merely "national" but also "inter-national" in its outlook, and we must "regard ourselves as the trustees for the world of those minerals within our territory which mankind in general needs".

BOTANY

President: Dr. K. Biswas

SYSTEMATIC AND TAXONOMICAL STUDIES ON THE FLORA OF INDIA AND BURMA

AFTER briefly reviewing the Systematic and Taxonomical researches in India and Burma, Dr. Biswas has given a detailed exposition of the ecological and phytogeographical vegetation belts of the different regions of the country, with special reference to endemism. The origin of the flora of Tibet is discussed in a comprehensive manner. Hooker's Theory of Endemism in India, according to the author, demands considerable alteration in the light of recent systematic and taxonomical researches. It is suggested that a detailed survey of the marine flora is likely to result in reducing the food problem of the country. There is a great need for ecological work based on systematic and taxonomical studies which has a very direct bearing on many problems of practical importance. Finally a plea is made for more organised team-work in the several Universities and Institutions on the subjects of ecology and systematic botany on certain definite lines which would promote our knowledge of "The New Systematics".

ZOOLOGY AND ENTOMOLOGY

President: Dr. B. Chopra

PRAWN FISHERIES OF INDIA

NEXT to agriculture and perhaps animal husbandry, fishing is the biggest industry of our country. Prawns and crabs form very important part of our fisheries. The fisheries provide employment and means of sustenance to lakhs of people all over India and their total annual yield runs into enormous figures. The marine prawn of very great commercial importance in India is *Penæus carinatus* Dana which is fished extensively along the Sind and Bombay coasts, in the back-waters of Malabar and all along the Eastern coast. There are a few other species of prawns of commercial value scattered all over the country. The most important fresh-water prawn is *Palæmon carcinus* Fabr. A single specimen may weigh well over a pound.

Prawn fishing is practised on a large scale in Bengal, Orissa, Madras, Travancore, Bombay and Sind. In Travancore prawn is extensively cultivated alternately with paddy in paddy-fields. Large quantities are consumed fresh and sent inland packed between layers of ice. Prawns are also sun-dried or smoked or boiled and sun-dried. These or very similar methods are prevalent almost all over India.

Great advances in prawn industry have been made in South Africa, Norway, California and other countries. In India it is in a very backward state. At present we know very little about the habits and life-history of the commercial species of prawns. The existing methods of fishing, preservation, transportation and marketing are very poor. The resources for the development of prawn industry are immense in this country. If the industry is properly organised on firm scientific and technological basis, it is certain to have a great future.

ANTHROPOLOGY AND ARCHÆOLOGY

President: Dr. N. P. Chakravarti

EPIGRAPHY AND ANTHROPOLOGY

AFTER paying a tribute to the departed anthropologists, Rai Bahadur Sarat Chandra Roy, Rai Bahadur Ramaprasad Chanda, Sir Flinders Petrie, Sir Arthur Evans, Monsieur Joseph Hackin and Sir J. G. Frazer, Dr. Chakravarti has reviewed the outstanding features of the work of the Archæological Department of the Government of India during the last year.

In the Sabarmati valley in Gujarat materials have been collected which are likely to throw some interesting light on the history of the Paleolithic, Neolithic and Iron Ages of India. A systematic excavation at Ahichchhatra, the capital of the ancient Panchala country, during the last two seasons, revealed the existence of five layers, virgin soil being reached 77 feet below datum. From the top, the first two layers belong to about the ninth and tenth centuries A.D., yielding Gadhaiya coins of Vigraha and Adi-Varaha types. The third stratum yielded an official Gupta sealing and evidently belonged to the Gupta period. The fourth

stratum was of the later Kushan period. The fifth which yielded coins of the Panchala type belonged to the Kushan period if not to the Sunga period. This ancient city was enclosed on all sides by massive ramparts of mud encased later in bricks with a network of bastions. Two large temples were found rising up in diminishing tiers, with a pradakshina-patha in each tier. These were two of the nine Deva temples found by Yuan Chwang. A number of terra-cotta figurines have been found in the place including the Mother Goddess, Mahishasuramardhini, etc.

Sir Auriel Stein explored the banks of the dry bed of the Ghaggar (or the Vedic Sarasvati) and discovered a large number of new sites dating from the chalcolithic times to the Kushan period. The more eastern of these sites date from the Kushan period while the more western at Derawar and Sandhanwala with their black-on-red and other painted pottery are connected with Mohenjo Daro culture. These researches have a direct bearing on the problem of desiccation in Asia.

Proceeding to his main theme of the connection of epigraphy with anthropology, Dr. Chakravarti summarised the history of writing as explained by Edward Clodd (*Story of the Alphabet*) though the Memonic, Pictorial, Ideographic and later stages and opined that epigraphy was invaluable for the study of anthropology, since epigraphs record authentically much valuable information about ethnic tribes, their customs and sociological culture; Asoka's inscriptions mention the Kamboja, Gandharas, Rathikas, Bhojas and Pitinikas. Associated with the Yavanas were the Scythian Sakas, the Kshaharatas and the Kushans, the last of whom according to Sten Konow belong to the stock *Homo alpinus* from Chinese Turkistan and are undoubtedly Iranian. Samudra Gupta's Allahabad inscription mentions a number of autonomous tribes such as the Malavas, Arjunayanas, Yaudheyas, Madrakas, Abhiras, Prarjunas, Sanakanikas, Kakas and Kharaparikaras. Other inscriptions mention the Hunas, the Bhils, the Gonds and even the Todas. The inscriptions serve the study of social anthropology by giving the traditional origin of many ruling families and by suggesting the foreign elements among the people of the country who were absorbed into Hindu society and also the matrimonial relations of indigenous and foreign ruling families. Light is thrown also on the development of the castes, of the gotras, of the matrimonial problems, etc.

Concluding Dr. Chakravarti hoped that the value of inscriptions in the study of anthropological problems would not be lost sight of by future scholars. M. H. KRISHNA.

MEDICAL AND VETERINARY SCIENCES

President: DR. F. C. MINETT

INFLUENCE OF CLIMATE ON THE INCIDENE OF DISEASE

DR. MINETT advocates a much closer liaison between Medical and Veterinary Workers in India as joint discussions and better collaboration between them, on the lines obtaining in Europe and America, would be of immense benefit to both professions. He next deals at length with the subject-matter of his paper "The Influence of Climate on the Incidence of Disease". This is a rather new field of investigation especially with reference to the domestic animals in India. Dr. Minett has been collecting all available and, as far as possible, authoritative information from the Provinces and also from the Indian States with regard to the incidence and spread of the several epizootics in the different seasons. Considering that India is a Continent where seasonal conditions vary considerably in the several parts of this country it is, indeed, a very difficult and a very long problem which only one of Dr. Minett's ability and experience could explore and elucidate. But the results of his investigations will have far-reaching and immense value in the prevention and control of epizootics. An accurate knowledge of the direct and what is equally important, the indirect influences, through changes in soil and fodder grasses by the seasonal variations, on the host and on the parasite and on the "Carriers" would be of utmost significance and we will be looking forward to Dr. Minett's valuable findings in this direction. S. D. A.

AGRICULTURAL SCIENCES

President: RAO BAHADUR Y. RAMACHANDRA RAO

THE NEED OF PLANNING ON AN ALL-INDIA BASIS IN CERTAIN ASPECTS OF AGRICULTURAL ENTOMOLOGY

INSECT pests in the Indian Peninsula can generally be classified as, firstly, those that are known to appear year by year on certain crops at particular seasons, mostly confined to particular localities and secondly, those, that have a considerable degree of mobility and that are capable of migrating long distances from the points of their origin. The Provincial Entomologists are well able to study and devise appropriate methods of dealing with the first group of pests; as regards the second group, as in the case of the Desert Locust, for example, an all-India agency is necessary to collect information on the movements of the pest from all likely breeding places, and circulate a warning to the provinces likely to be affected. While, such an agency is already functioning in respect of the Desert Locust, none has yet come into existence to deal with two other Indian locusts of potential danger, namely, the Bombay Locust and the Migratory Locust. Moreover, sufficient information about the breeding grounds, and areas of distribution and migration of these locusts has not been available; nor has any knowledge of the factors that are likely to favour the mass multiplication and swarming propensity of these locusts been gained so far.

Besides locusts, other insects like the paddy Army worm in South India, and cutworm in Bihar, are pests that migrate and spread over considerable areas during certain years. The Deccan grasshoppers invading contiguous areas in four different political territories is a

problem by itself requiring extensive studies by a central body operating in all the territories as a single unit.

The case of the great locust infestation of South India in 1878 is extremely interesting. Severe infestation had occurred over the whole of the Carnatic and Mysore and part of the Deccan. Though it is true that the invasion was an abnormal development, due to unusual drought condition in 1876, it would show that there is nowhere a real immunity in South India. If the centres of outbreak are situated in the grass areas of the hill ranges, there is every likelihood of a recurrence of locust outbreak if conditions should become favourable.

Old records of about sixty years ago, regarding the locust invasion of 1878 recovered from Government offices, have given very valuable information about the migratory locust.

The vital need would appear to be a well-thought-out plan of research, on an all-India basis, by a central body of agricultural scientists, including entomologists, who should tackle such problems as cannot obviously be worked by a provincial agency. Such problems may include investigation on pests capable of migrating from one province to another, like the Bombay locust, the Deccan grasshopper and the Army and cutworms, and also research in matters of fundamental importance. In addition, the results of work undertaken by provincial authorities that remain unpublished for long periods for want of facilities and opportunities, should be collected periodically and examined by a central agency, for preventing overlapping in research and also for the purpose of pooling of available knowledge useful to the whole of India. The recommendations of this body could later be considered by the Imperial Council of Agricultural Research for sanction of funds, for publishing useful records and making them available all over India. It is with the help of central organisations that much of very necessary and important investigation about certain insect pests of potential danger to large tracts in India, can be conducted and later, effective measures of control adopted in time.

PHYSIOLOGY

President: Prof. B. Narayana

THE GROWTH OF PHYSIOLOGY AS AN EXPERIMENTAL SCIENCE

PROF. B. NARAYANA has traced the growth of physiology as such and has presented before us not only the researches done in the past but also those that have been done in recent years. He has gone back to the earliest days when physiology as such was not known. Since physiology is intimately associated with anatomy, medicine and surgery, it is only natural that he has referred to these in the course of his address.

Tracing from the days of Hippocrates the author passes on to the post-Hippocratic period when two notable schools of medicine were founded in Alexandria, one by Herophilus of Chalcidan (300 B.C.) and the other by Erasistratus (260 B.C.). He then passes from the third century B.C. to the second century A.D., when Galen flourished. In Galen, the ideas of Hippocratic writers were maintained but were given a Galenic stamp.

The birth of modern science of anatomy and physiology began from the time of Andreas Vaselius who was born on the new year's night 1514-15. Vaselius' attitude was that observations and not authority were standards to be followed. He laid the foundation of experimental methods so securely that his students and disciples never appealed to him as an authority but for judgment to what could be seen and demonstrated. His book *The Fabric of the Human Anatomy*, published in 1543, was the beginning of not only of modern anatomy but of modern physiology as well. Later on in the hand of Henry anatomy took a new shape and became physiology. From this time onwards physiology was inseparably associated with anatomy and physiological explanation was acceptable only if it was anatomically possible.

Coming to the nineteenth century, physiologists like Johannes Muller, Helmholtz and Ludwig in Germany and Claude Burnard in France had considerable influence on the growth of physiology in Europe. The influence of Claude Burnard on the development of physiology as an experimental science was considerable.

It is unfortunate that physiology was not so highly developed at the time as an experimental science in Great Britain as on the continent. It was not until 1836 that Sharpey exerted his influence on the spread of physiology as an experimental science in Great Britain. Later on he induced Michael Foster to take up the study of practical physiology and to him physiology owes a deep gratitude as he took active part in founding the British Physiological Society in 1886. Gradually many centres of physiological research in Great Britain were established.

Having given a brief review of the work done by various physiologists at different centres the author discusses more fully one of the important subjects in which work has been done in recent years and further work is in progress.—"The Physiology of the Pulmonary and Bronchial Vascular System". Recent work on the subject shows that the reactions of the various parts of the pulmonary vascular bed to nervous and chemical influences are not always similar and that any given response of the lung as a whole must be considered as the resultant of a number of reactions in different parts. Recently the relationship of physiology to surgery has also been recognized and it has been realised that physiology must take the help of surgery to solve many of its intricate problems and that surgery cannot make any real advance unless it goes hand in hand with physiology.

In conclusion it has been pointed out that ways and means must be found whereby this experimental science can grow as rapidly in this country as in others. An atmosphere of research should be created in all the physiological laboratories. It will also be of very great value if attached to a department of physiology, a purely research department, called the Department of Experimental Medicine be created.

ENGINEERING AND METALLURGY

President: N. V. MODAK, B.E., M.I.C.E., M.I.E. (India), F.R.San.I., J.P.

THE THEORY AND PRACTICE OF SEWAGE PURIFICATION, WITH PARTICULAR REFERENCE TO WORKS AT DADAR, BOMBAY

BOMBAY is the first city in India to operate sewage purification works under skilled technical and scientific supervision with requisite laboratory control. Mr. Modak presents in this address, after a brief review of the modern trends in sewage disposal practice, a number of data and statistics collected at the Dadar plant, so that they may prove useful to engineers and chemists engaged in similar works in India.

The most marked trend in modernisation is the mechanisation of the treatment plant. Though economic considerations play an important part in the selection of apparatus or otherwise, plants installed in the midst of residential areas should be provided with mechanical appliances as they are helpful in minimising nuisance from smell when the various daily operations required for the efficient performance of the plant as a whole are carried out.

The next trend is in regard to pre-treatment of sewage prior to its entry into the preliminary sedimentation tanks. Pre-treatment has been developed on two lines, pre-aeration and flocculation. Pre-aeration is helpful in keeping the sewage fresh, and in the separation of grease. Flocculation is practised either with submerged paddles, having a peripheral speed of 1·5 to 1·7 f.p.s. or by blowing 0·05 to 0·2 cu.f. of air per gallon of sewage treated. Paddles give better results than compressed air. Flocculation with paddles is also adopted in the case of chemical precipitation tanks to secure thorough mixing of chemicals. Chemical precipitation is being revived, the sedimentation tanks being used for the purpose during the hot months when the sewage is very strong.

The Activated Sludge process has now passed the experimental stage and has become the most prominent mode of treatment. It can safely be relied upon to produce stable and sparkling effluents both for large and small installations, provided, skilled and scientific supervision can be afforded for its scientific operation. The process is, however, "very sensitive" and gets easily upset by factors like septicity, variations in quantity and strength of raw sewage, and the relatively large proportions of industrial wastes. Aeration is carried out with either diffused air or surface aeration, *i.e.*, mechanical agitation. The diffused air method is economical for plants of greater capacity than 4 m.g.d., while for smaller capacities the choice must be based on considerations of local conditions, and variations in flow and characteristics of sewage.

In Great Britain a number of activated sludge plants have been introduced between the existing sedimentation tanks, and the biological filters. Here the activated sludge process is employed to remove only the colloidal matter from sewage, *i.e.*, it is worked up to the clarification stage, and the filters, being more suited for the nitrification of dissolved organic matter, complete the nitrification stage.

It was thought that with the advent of the activated sludge process, the biological filters would not be considered for new installations. But as more experience was gained in the working of activated sludge process, and in particular about its sensitiveness, the troubles above mentioned were noticed, and people had to take recourse to biological filters which could withstand sudden variations in the strength and volume of sewage treated. The main drawbacks of this, however, are its large space requirement, aerial nuisance from smell and fly nuisance. These are now overcome by suitable means such as enclosing the filters and provision of forced draft aeration. Pilot plants have given such satisfactory results that this plant has a bright future, as it is cheap both in initial cost and operation cost, than the activated sludge process. Experimental work is, however, in progress to achieve further modifications of the filter such as stage filtration. There is no doubt that the old biological filter with suitable modifications will considerably influence the technique of sewage purification in the near future. An enclosed filter using forced draft aeration is in operation at Dadar from April 1941.

Sludge disposal is practised either by land treatment of sludge or burying or lagooning or drying in the open on beds. The first requires large space and has, therefore, fallen to the background, whereas the latter ones create nuisance. Pressing is adopted in many places and vacuum filters are used in several others, the dried sludge being sold as a fertiliser. Digestion of sludge in separate tanks called "digesters" is in practice, superseding the older methods. The gas obtained from digestion is used for power and fuel purposes. A single stage "digestion tank" is in operation at Dadar for five years. This is the first of its kind in India. Sixty thousand c.ft. per day of a gas of calorific value 600-650 B.T.U. per c.ft., are collected and while 25 per cent. of this is already being used for cooking and heating purposes in the K.E.M. Hospital, methods for utilisation of the remainder are being vigorously developed.

The sewage purification plant at Dadar is designed and operated for producing an effluent conforming to the standards laid down by the Rivers Pollution Board, England, for "combined" sewage. It was intended to extend this plant from 4 to 8 m.g.d., but due to conditions created by the war the work on the extension had to be deferred and the plant has, therefore, been overloaded. The total flow reaching the plant is about 10 m.g.d., out of which 5 m.g.d. are treated in the activated sludge plant, about 0·75 m.g.d. in the enclosed filter, and the remainder is bypassed after preliminary settlement into the open storm water drain close by. Full details of data and operation of the several units comprising the plant are presented and discussed.

S. K. L. NARAYANA.

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